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A USER'S MANUAL FOR THE SEQUENCE ACCOUNTABLE FATIGUE ANALYSIS COMPUTER PROGRAM

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FORWARD

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ABSTRACT

This report presents a detailed description of a computer program to calculate cumulative damage of notched structural members subjected to arbitrary spectra. The Sequence Accountable Fatigue Analysis computer program develops its sequence sensitivity by tracking residual stresses local to a notch throughout the spectrum of loads. Residual stress relaxation analysis is included to increase the generality of the results. An example spectrum and resulting cumulative damage analysis are illustrated.

TABLE OF CONTENTS

SYMBOLS

σ_{res}	Residual stress
σ_{max}	Maximum local stress level
σ_{min}	Minimum local stress level
σ_{ys}	Yield stress
$\sigma_{res_{EQ}}$	Equilibrium component of the residual stress
ε_t	Local strain, total
ε_e	Elastic component of total strain
ε_p	Plastic component of total strain
S_{max}	Maximum applied stress level
S_{min}	Minimum applied stress level
S_{mean}	Mean applied stress level, $(S_{max} + S_{min})/2$
K_t	Elastic stress concentration Factor
D	Damage
I	Integer describing the level number
N_{EP}	Equilibrium period, number of cycles for the local stresses to return approximately to the equilibrium conditions following an overload
C1	Residual stress relaxation constant
E1, E2	Relaxation function exponents
N	Number of cycles
E	Modulus of elasticity
N_f	Number of cycles of life at a given stress or strain cycling level
ε_f'	Strain intercept at one reversal on a log ε_p-log life curve
c	Slope of the log ε_p-log life curve

SECTION I

INTRODUCTION

Cumulative damage analyses based upon the local stress-strain behavior at a notch appear to be reasonably successful in anticipating trends in fatigue life behavior of notched specimens subjected to spectrum loading [1-6]. The type of behavior that usually occurs is that peak tensile loads tend to increase the fatigue life and peak compressive loads tend to decrease the life of notched structures compared to structures experiencing load spectra not having those peaks [5,6]. Local behavior analyses, such as those developed by Smith [7] and Neuber [8], help to explain this phenomenon as being a result of the tensile peak load creating a compressive residual stress at the notch and, conversely, the compressive peak creating a tensile residual stress. The change in life occurs because the residual stress state modifies the subsequent damage accumulation rates.

The Sequence Accountable Fatigue Analysis computer program was developed to incorporate the local stress-strain approach with a recent residual stress relaxation analysis [6] in order to improve the sequence sensitivity of cumulative damage analysis. This technical memorandum presents the details of the resultant computer program and an example of its use. The correlation of predictions made with this analysis to actual results of tests experiencing spectrum loading is presented by Potter [9] and Potter and Noble [10].

SECTION II

PROGRAM OUTLINE

The Sequence Accountable Fatigue Analysis traces the stress-strain behavior local to a notch throughout an applied load spectrum and calculates the damage based on the local experience. The computer program is divided generally into the four parts or modules outlined in Fig. 1.

The basic input data for the material, specimen geometry, fatigue behavior qualities and spectrum, are developed in Module I. Module I is discussed further in Section III. Module II takes the input information and determines the local stress-strain behavior. Module III references the Range Pair Counting Method Subroutine to cycle count the local stress spectrum. Module IV determines the damage in the local stress-strain spectrum.

The basic analyses used in Modules II, III and IV are presented below.

Module II - Local Stress-Strain Behavior - The analysis used during the determination of the local stress behavior during the spectrum of loading is a combination of analyses developed by Smith [7], Neuber [8] and Potter [6]. Smith's simple analysis indicated that the residual stress could be approximated by assuming that the initial stress-strain behavior was elastic upon unloading following plastic flow. Thus, the residual stress could be calculated knowing the

maximum local stress and the maximum applied stress as in Eq. 1 and in Fig. 2.

$$\sigma_{res_i} = \sigma_{max_i} - K_t S_{max_i} \qquad (1)$$

The Sequence Accountable Fatigue Analysis computer program currently incorporates elastic-perfectly plastic stress-strain behavior. Therefore, σ_{max_i} is equal to the yield stress. For the cycles immediately following the peak stress, the residual stress determined in Eq. 1 modifies the elastic solution as shown in Eqs. 2 and 3 (provided that the following maximum applied stress is less than S_{max} and that there is no change in the residual stress due to a minimum applied stress causing reversed yielding).

$$\sigma'_{max_i} = \sigma_{res_{i-1}} + K_t S_{max_i} \qquad (2)$$

$$\sigma_{max_i} = \sigma_{res_{i-1}} + K_t S_{max_i} \qquad (3)$$

The analysis developed by Neuber [8] has been extended to cyclic loading by Wetzel [2] and Wetzel, Morrow and Topper [3] and used by many others [1,4-6] primarily to determine local stress-strain behavior. It is used in this program only to calculate plastic strains occurring when the residual stress undergoes a step change. The plastic strain calculation routine is accessed only when the σ_{max_i} or σ_{min_i} terms in Eqs. 2 and 3 exceed tensile or compressive yield stress levels, respectively. Figure 3 illustrates the calculation of the plastic strain.

The local stress-strain behavior, according to Wetzel [2] is related to the applied load by Eq. 4

$$\sigma \cdot \varepsilon = (K_t S_{max})^2/E \qquad (4)$$

The plastic strain can be found by subtracting the elastic component from the total strain.

$$\varepsilon_p = \varepsilon_t - \varepsilon_e = (K_t S_{max})^2/E\cdot\sigma_{max} - \sigma_{max}/E$$

Therefore, the plastic strain associated with S_{max_i} is given in Eq. 5.

$$\varepsilon_{p_i} = (K_t S_{max_i})^2/E\sigma_{ys} - \sigma_{ys}/E \qquad (5)$$

If a residual stress existed prior to this plastic strain excursion, the plastic strain associated with that prior excursion is subtracted from Eq. 5 as shown in Eq. 6.

$$\varepsilon_{p_i} = (K_t S_{max_i})^2/E\sigma_{ys} - (\sigma_{ys} - \sigma_{res_{i-1}})^2/E\sigma_{ys} \qquad (6)$$

A similar calculation is made for plastic strains occurring during the minimum stress peak.

In the analysis developed by Potter [6] the residual stress cyclically relaxes toward zero or an equilibrium residual stress as shown in Fig. 4 according to Eq. 7.

$$\sigma_{res_{N=1,2,\ldots}} = (\sigma_{res_{N=1}} - \sigma_{res_{EQ}})\exp(N/N_{EP_i}\ln(0.1)) \qquad (7)$$

The N_{EP} term, the Equilibrium Period, is dependent upon the applied stress and the Residual Stress Relaxation Constant.

$$N_{EP_i} = (C1/(K_t S_{max_i}{}^{E1}\cdot K_t S_{mean_i}{}^{E2})) \qquad (8)$$

The Residual Stress Relaxation Constant, C1, has not yet been experimentally defined but should be a constant for a material.

Module III - Cycle Counting Method

After the local stress and plastic strain behavior is calculated, the local stress spectrum is Range Pair Counted using a computer program developed by Tischler.[11]

Module IV - Damage Calculation

Damage is calculated separately for the plastic strain excursions and the elastic stress spectrum. The damage is determined from the conventional $D = \sum \frac{n}{N}$ calculation. Damage from each of the plastic strain cycles is determined from the Coffin-Manson [12] form

$$D_i = 1./N_{f_i} = 1./(\varepsilon_{p_i}/\varepsilon_{f'})^{1/c}$$

Damage from the elastic stress cycles is determined in a similar manner. The maximum and minimum local stress levels are sequentially compared to unnotched S-N data in a Modified Goodman Diagram format. Damage is summed, and failure of the coupon is defined as the event occurring when the summed damage equals unity.

SECTION III

INPUT DATA REQUIREMENTS

In general, each spectrum analyzed will require slightly different programming in order to get the load history into a usable format for the core program. The basic program requires a certain family of information before any analytical predictions can be made. Appendix I contains a program listing for the Sequence Accountable Fatigue Analysis. The subroutine CORE which accesses the subroutines having to do with RPCM, the Range Pair Counting Method, contains the basic analysis. Subroutine SAL reads the data input and then references subroutine CORE. The subroutine SAL shown is one in which a block of cycles is repeated with optional cycles. A list of the input data cards and the resulting analysis is given in Appendix II.

The specific data requirements are given below.

1. Stress-Strain Behavior - The stress-strain behavior is presumed to be elastic - perfectly plastic with the tensile yield stress being equal to the compressive yield stress. The yield stress value used is an average of the monotonic behavior generally being above the 0.2% yield value and below the engineering ultimate strength.

2. Residual Stress Relaxation - The residual stress relaxation behavior of Eq. 7 and 8 is characterized by C1, the Residual Stress Relaxation Constant and E1 and E2, the relaxation equation exponents. The Residual Stress Relaxation Constant, C1, has not yet been adequately determined. It should be a material property if the relaxation function

is correct and must be assumed. A reasonably accurate estimate of the Residual Stress Relaxation Constant for aluminum material falls in the range of 5-20 x 10^6 (cycles) $(Ksi)^2$. Further experimentation on the part of the analyst should develop a C1 usable for his set of conditions until actual measurement of residual stress relaxation behavior defines the relaxation function and constants. At present E1 and E2 are considered to be equal to 1.0.

3. Specimen Geometry - The elastic K_t value (if available) is entered into the analysis. If that value is not available then an estimate from some other method may be used. In certain cases, a value may be determined from a constant amplitude fatigue test of a similar structure by fitting several values of K_t to the analysis and determining the best correlation as is done with the K_f solution. Once a stress concentration factor, K_t, is determined for a specimen, that value is not changed from test-to-test of the same coupon configuration.

4. Load Multiplier - Different spectra are presented for analysis in different manners. Some data are presented in percent of maximum stress, others in terms of nominal stress, and others in terms of bending moment. The value of the load multiplier defines the nominal stress history.

5. Cumulative Damage Analysis - The damage from the range-paired elastic stress spectrum is determined by calculating a simple $\frac{n}{N}$ value for each level and accumulating the total. The N_{f_i} value is determined from unnotched coupon S-N data in the Modified Goodman Diagram format.

The program requires the input of four second order equations describing the maximum and minimum stress levels at lives of 10^4, 10^5, 10^6 and 10^7 cycles. The coefficients of the equations are derived by least square fitting the S-N data presented in the form of Eq. 9.

$$S_{max}=A(I)S_{min}^2+B(I)S_{min}+C(I) \tag{9}$$

The A, B, and C coefficients for several typical materials are presented in Appendix IV. The S-N data shown was derived from various sources but usually from the MIL-HDBK-5A [13]. The C coefficients correspond to the maximum stress level at zero to maximum applied stress conditions on the unnotched coupons.

The damage from the plastic strain cycles is determined using the Coffin-Manson relation to calculate the N_{f_i} value. The conventional plastic strain intercept at one reversal and the ε_p - life slope values are used in the analysis. Specific measured values from the literature are used when available and typical values when they are not available.

6. Analysis or Test Spectrum - The last information needed is the order and magnitude of application of the spectrum used in the test.

SECTION IV

OUTPUT OPTIONS

The Computer Program prints the following output in the process of the analysis.

1. Maximum and minimum applied stress and local stress response through the spectrum. Also printed out is the residual stress, equilibrium stress, applied cycles, and the equilibrium period.

2. The elastic local stress history as input into the Range Pair Subroutine and the resulting Range Paired spectrum.

3. The plastic strain occurrence during the spectrum and the damage associated with each strain reversal.

4. The accumulated damage associated with the plastic strains.

5. The Range Paired elastic stress spectrum and the damage associated with each level.

6. The accumulated damage associated with the current block of loading including the plastic strain damage and the total damage since the initiation of cycling.

At the option of the analyst, he can print out all the above items or only two. The IPRINT value controls what data is printed.

If IPRINT = 1, all six items are printed for each flight or block.

If IPRINT = 2, all items except 2. above are printed.

If IPRINT = 3, only items 4. and 6. above are printed.

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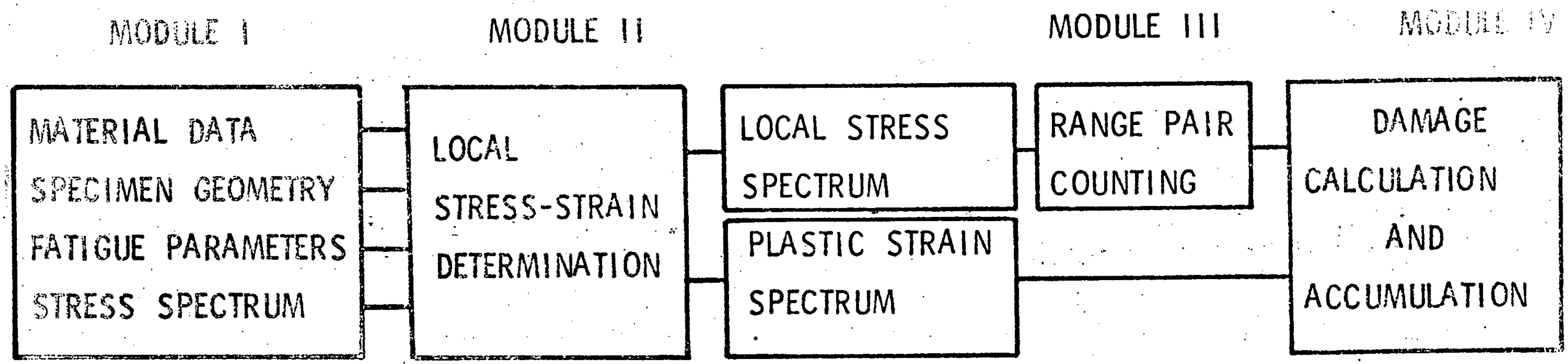

FIGURE 1. PROCEDURE USED IN THE SEQUENCE ACCOUNTABLE FATIGUE ANALYSIS

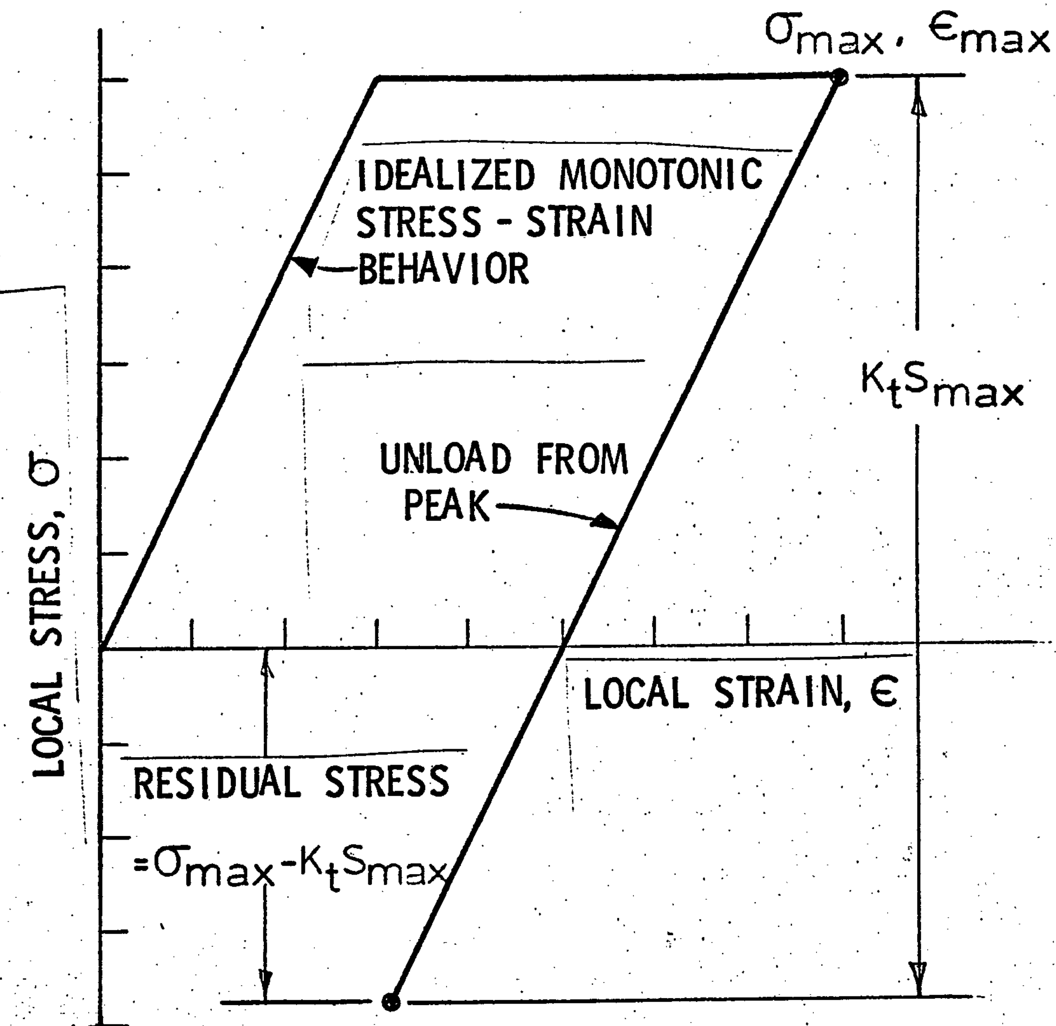

FIGURE 2. METHOD OF DETERMINING THE RESIDUAL STRESS FOLLOWING A PEAK LOAD

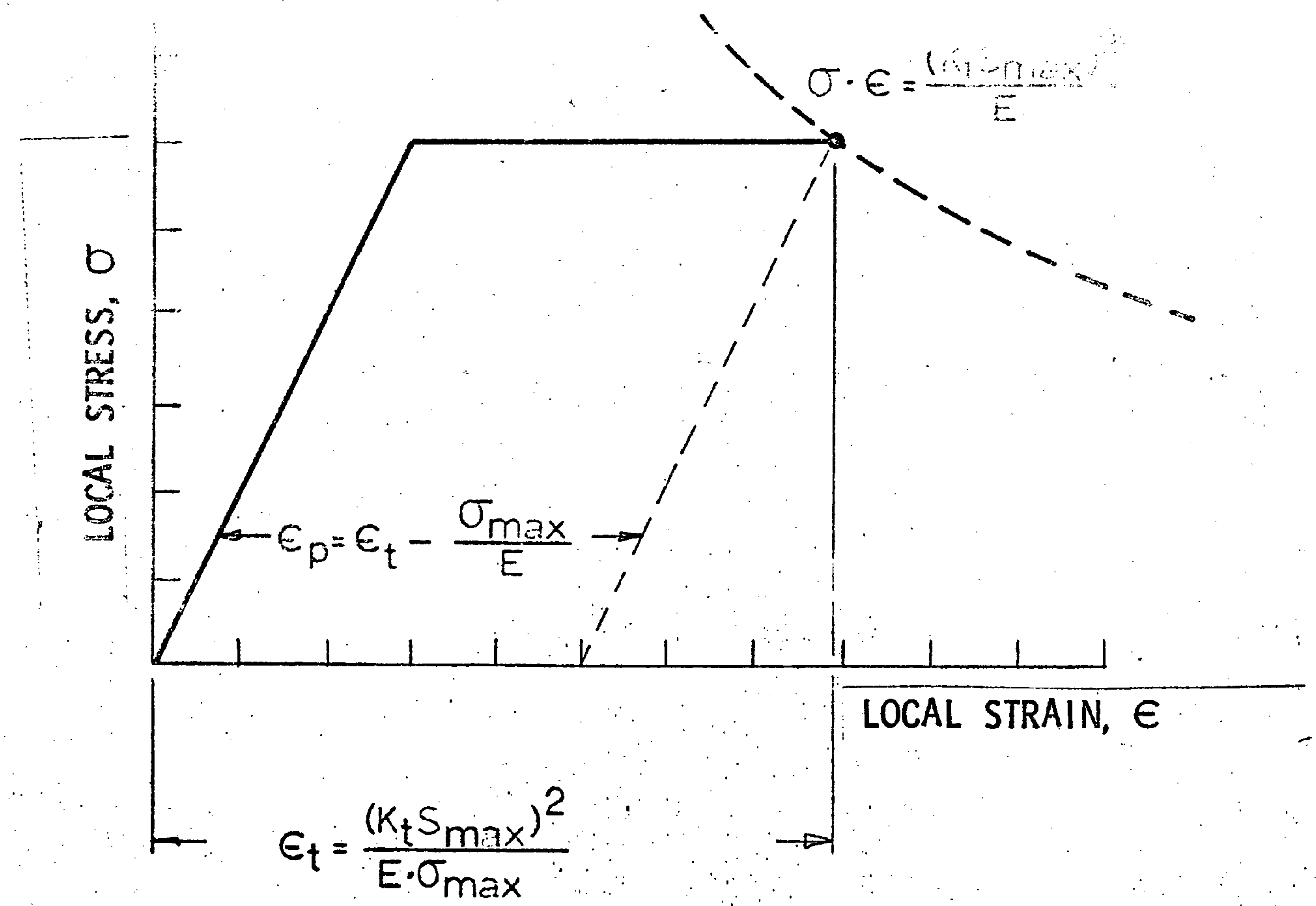

FIGURE 3. METHOD OF DETERMINING PLASTIC STRAIN LEVELS

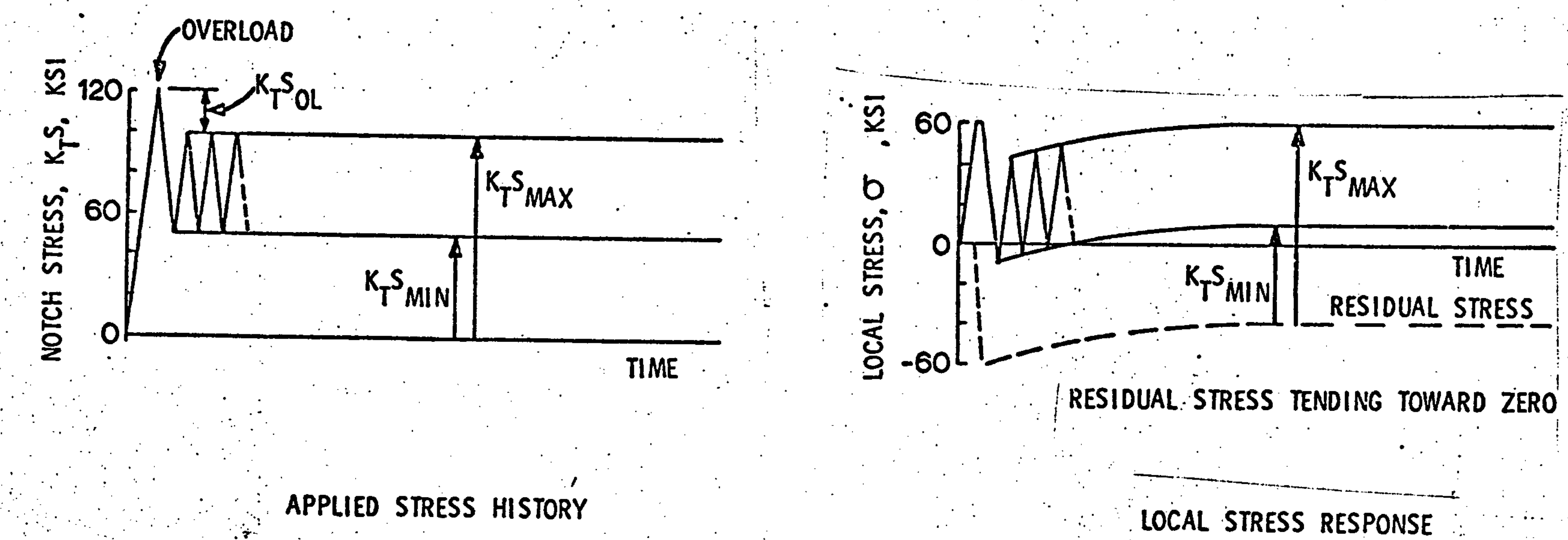

FIGURE 4. LOCAL STRESS RESPONSE FOR APPLIED CONSTANT AMPLITUDE LOADING WITH RESIDUAL STRESS RELAXATION

APPENDIX I

PROGRAM LIST

```
                              CDC 6600 FTN V3.0-351A OPT=1  09/15/73
      PROGRAM SAL(INPUT,TAPE5=INPUT,OUTPUT,TAPE6=OUTPUT)
C
C     ************************************************************************
C
C                          MODULE I
C                INPUT ROUTINE FOR THE
C      SEQUENCE ACCOUNTABLE FATIGUE ANALYSIS
C
C     ************************************************************************
C
C             PROGRAM DEVELOPED BY  JOHN M. POTTER AND ROBERT A. NOBLE
C                 OF THE AIR FORCE FLIGHT DYNAMICS LABORATORY
C                      MARCH 1973
C                   ADDRESS: AFFDL/FBR
C                           WRIGHT-PATTERSON AFB,OHIO  45433
C                   TELEPHONE  (513) 255-6104  OR  255-6105
C
C     INPUT
C
C
C     DATA CARD 1.     NDECK = THE NUMBER OF DATA DECKS TO BE RUN SEQUENTIALLY.
C                      IPRINT   THE VALUE CONTROLLING THE WRITE STATEMENTS
C                                  1  PERMITS MAXIMUM PRINTOUT
C                                  2  SUPPRESSES RAINFLOW PRINTING
C                                  3  MAXIMUM SUPPRESSION OF PRINTOUT
C                      IRPCM= THE VALUE CONTROLLING THE ENTRY INTO THE
C                             RANGE PAIR COUNTING SUBROUTINE
C                                  1  ENTER RANGE PAIR COUNTING SUBROUTINE
C                                  2  SKIP RANGE PAIR COUNTING SUBROUTINE
C                      FORMAT  3I4
C
C     EACH DATA DECK CONTAINS THE FOLLOWING CARDS --
C
C     CARD 1.       TEST IDENTIFYING INFORMATION
C                   FORMAT  8A8
C
C     CARD 2.       TM     = MATERIAL TYPE
C                   TYS    = TENSILE YIELD STRESS (KSI)
C                   EPSD   = LCF STRAIN INTERCEPT
C                   COFMAN = INVERSE OF COFFIN-MANSON SLOPE
C                   ELMOD=  MODULUS OF ELASTICITY  (KSI)
C                   FORMAT 2A8,3F18.5,F10.2
C
C     CARDS 3,...,6.   A(N)   N=4,7    (A,B,C ARE COEFFICIENTS OF SECOND
C                                      (ORDER LEAST SQUARE FIT OF S-N DATA,
C                      B(N)            (FOR CURVE OF 10**N CYCLES.)
C                      C(N)            (STMAX = A(N)*STMIN**2 + B(N)*STMIN + C(N))
C                      TITLE1          (TITLE1,TITLE2 IDENTIFIES THE        )
C                      TITLE2          (SOURCE OF THE S-N DATA               )
C                      N               (PUNCHED IN COLUMN 72. FOR INFO.)
C                      MATERIAL TYPE   (COLUMNS 73-80. FOR INFO ONLY.   )
C                      FORMAT 3F18.5,2A8
C
C     CARD 7.       C1                 (CONSTANTS TO BE USED IN CALCULA-  )
```

```
C                    E1                  (TION OF EQUILIBRIUM PERIOD, ENEP.)
C                    E2                  (ENEP=C1/(KTSMAX**E1*KTSMEAN**E2) )
C                    FORMAT   3F18.5
C
C       CARD 8.      AKT = STRESS CONCENTRATION FACTOR USED THE FIRST
C                          TIME THROUGH THE PROGRAM
C                    ZKT = STRESS CONCENTRATION FACTOR USED THE LAST
C                          TIME THROUGH THE PROGRAM
C                    DELAKT = STEP CHANGE IN KT BETWEEN RUNS
C                    FORMAT   3F18.5
C
C       CARD 9.      NBLOCK = NUMBER OF BLOCKS (NO. OF TIMES TO REPEAT LIST
C                                                            OF LOADS)
C                    NLEVEL = NUMBER OF LOADS
C                    NTYPE  = NUMBER OF TYPES OF LOADS
C                    FORMAT   3I10
C
C       CARD 10.     TLL = LIMIT LOAD
C                    FORMAT   F18.5
C
C       CARDS 11,...,NLEVEL + 10.
C                    ISTEP(K) = K = THE KTH STEP        (K=1,NLEVEL)
C                    ITYPE(K) = THE IDENTIFYING TYPE OF THE KTH LOAD
C                    STMIN(K) = THE KTH MINIMUM (DECIMAL FRACTION OF TLL)
C                    STMAX(K) = THE KTH MAXIMUM (DECIMAL FRACTION OF TLL)
C                    ENN(K)   = NUMBER OF CYCLES AT THE KTH LOAD
C                    FORMAT   2(I4,2X),3(F18.5,1X)
C
C       CARDS NLEVEL + 11,...,NLEVEL + 10 + NBLOCK.
C                    IBLOCK(JJ) = JJ = THE JJTH BLOCK       (JJ=1,NBLOCK)
C                    NN(JJ,1)   = TYPE OF LOAD INCLUDED IN JJTH BLOCK
C                    NN(JJ,2)   =           (THERE WILL BE ONE NN VALUE      )
C                    NN(JJ, )   =           (ON THE CARD FOR EACH DIFFERENT  )
C                    FORMAT   9I5           (TYPE OF LOAD INCLUDED IN THE    )
C                                           (JJTH BLOCK                      )
C
      COMMON/MSAL/RNCYC(200),KPMAX,IPRINT
      DIMENSION RTMIN(200),RTMAX(200),RNN(200),ITYPE(200)
      COMMON/MCOR1/NLEVEL,IRPCM,IPLOT,ELMOD,TYS,EPSD,COFMAN,C1,E2,E1,
     *RES(200),AKT,SUMENN,SUMNC
      COMMON/MCOR2/STMIN(200),STMAX(200),ENN(200),A(10),B(10),C(10),
     *R(10),ISTEP(200),NN(200,10),IBLOCK(200)
      READ(5,4) NDECK,IPRINT,IRPCM
    4  FORMAT(3I4)
      WRITE(6,3) NDECK
    3 FORMAT(1H1,I4,32H DATA DECKS ARE TO BE PROCESSED.)
      IF(IRPCM.GE.2)GO TO 6
      WRITE(6,11)
      GO TO 13
    6 WRITE(6,7)
    7 FORMAT(25H NO COUNTING METHODS USED)
   13 CONTINUE
      DO 595 LMN = 1,NDECK
      WRITE(6,5)
    5 FORMAT(40H SEQUENCE ACCOUNTABLE FATIGUE EVALUATION)
```

```
      READ(5,9)T1,T2,T3,T4,T5,T6,T7,T8
    9 FORMAT(8A8)
      WRITE(6,8)T1,T2,T3,T4,T5,T6,T7,T8
    8 FORMAT(16H1SPECTRUM FROM   ,8A8)
C
C         INPUT OF DATA PECULIAR TO A MATERIAL
C
      READ(5,10)TM1,TM2,TYS,EPSD,COFMAN,ELMOD
   10 FORMAT(2A8,3F18.5,F10.2)
      WRITE(6,12)TM1,TM2,TYS,EPSD,COFMAN,ELMOD
   12 FORMAT(18H MATERIAL TYPE -- ,2A8,//30H TENSILE YIELD STRESS (KSI)
     *--,F18.5,//23H LCF STRAIN INTERCEPT =,F18.5,//31H INVERSE OF COFFI
     *N-MANSON SLOPE,F18.5,//18H ELASTIC MODULUS =,F18.5)
      READ(5,14) (A(N),B(N),C(N),TITLE1,TITLE2,N=4,7)
   14 FORMAT(3F18.5,2A8)
      WRITE(6,16)
   16 FORMAT(58H0COEFFICIENTS OF SECOND ORDER LEAST SQUARE FIT OF S-N DA
     *TA)
      WRITE(6,18)
   18 FORMAT(44H       SMAX = A(I)*SMIN**2 + B(I)*SMIN + C(I))
      WRITE(6,20)
   20 FORMAT(5X,5H LIFE,10X,5H A(I),14X,5H B(I),14X,5H C(I))
      WRITE(6,22)(N,A(N),B(N),C(N),N=4,7)
   22 FORMAT(8H    10**,I2,3F18.5)
      WRITE(6,56) TITLE1,TITLE2
   56 FORMAT(39H0UNNOTCHED COUPON S-N DATA DERIVED FROM/28H INFORMATION
     *SUPPLIED FROM   ,2A8)
      READ(5,14) C1,E1,E2
      WRITE(6,24)
   24 FORMAT(36H0RESIDUAL STRESS RELAXATION FUNCTION)
      WRITE(6,26)
   26 FORMAT(/42H       ENEP = C1/(KTSMAX**E1 * KTSMEAN**E2)/)
      WRITE(6,28) C1,E1,E2
   28 FORMAT(13H WHERE   C1 =,E15.8,9H ,    E1 =,F10.3,10H AND  E2 =,F10.
     *3)
C
C
C
C         INPUT OF DATA PECULIAR TO A SEQUENCE
C
C
      READ(5,65)AKT
   65 FORMAT(F18.5)
      READ(5,32) NBLOCK,JLEVEL,NTYPE
   32 FORMAT(3I10)
      WRITE(6,34) NBLOCK,JLEVEL
   34 FORMAT(// I10,23H TIMES THROUGH BLOCK OF,I10,6H LOADS)
      READ(5,35) TLL
   35 FORMAT(F18.5)
      WRITE(6,33) TLL
   33 FORMAT(/ 5X,13H LOAD LIMIT =,F18.5)
      READ(5,36)(ISTEP(K),ITYPE(K),RTMIN(K),RTMAX(K),RNN(K),K=1,JLEVEL)
   36 FORMAT(I4,2X,I4,2X,F18.5,1X,F18.5,1X,F18.5,1X)
      WRITE(6,38)
   38 FORMAT(//11H STEP  TYPE,10X,6H STMIN,14X,6H STMAX,15X,4H ENN)
```

```
      WRITE(6,36)(ISTEP(K),ITYPE(K),RTMIN(K),RTMAX(K),RNN(K),K=1,JLEVEL)
      WRITE(6,39)
   39 FORMAT(//47H BLOCK  TYPE TYPE TYPE TYPE TYPE TYPE TYPE TYPE/)
      DO 42 JJ=1,NBLOCK
      READ(5,40) IBLOCK(JJ),(NN(JJ,KK),KK=1,NTYPE)
      WRITE(6,40) IBLOCK(JJ),(NN(JJ,KK),KK=1,NTYPE)
   40 FORMAT(9I5)
   42 CONTINUE
      SUMENN=0.
      SUMNC=0.
      RES(1)=0.
       WRITE(6,8)T1,T2,T3,T4,T5,T6,T7,T8
      WRITE(6,51) (AKT)
   51 FORMAT(/7H AKT = ,(F6.2))
        WRITE(6,55)C1
   55 FORMAT(//24H RELAXATION CONSTANT C1=,F15.2)
       IF(IRPCM.GE.2)GO TO 59
      WRITE(6,11)
   11 FORMAT(56HOSPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE)
     *)
   59 CONTINUE
      DO 1002 KFL=1,NBLOCK
       JJJ=1
      DO 60 J=1,JLEVEL
      DO 70 KK=1,NTYPE
       IF(NN(KFL,KK).EQ.0) GO TO 60
       IF(ITYPE(J).EQ.NN(KFL,KK))GO TO 150
   70 CONTINUE
  150  STMIN(JJJ)=RTMIN(J)*TLL
       STMAX(JJJ)=RTMAX(J)*TLL
       ENN(JJJ)=RNN(J)
      JJJ=JJJ+1
   60 CONTINUE
       NLEVEL=JJJ-1
      CALL CORE(KFL)
       IPRINT=2
 1002 CONTINUE
  597 CONTINUE
  595 CONTINUE
  596 CONTINUE
  580 STOP
      END
```

```
      SUBROUTINE CORE(KFL)                                             CORE       2
C**********************************************************************CORE       3
C                                                                      CORE       4
C                         CORE PROGRAM OF                              CORE       5
C                  THE SEQUENCE ACCOUNTABLE FATIGUE ANALYSIS           CORE       6
C                                                                      CORE       7
C                                                                      CORE       8
C                             MODULE II                                STD        1
C                                                                      CORE      10
C                LOCAL STRESS AND STRAIN DETERMINATION                 CORE      11
C                                                                      CORE      12
C**********************************************************************CORE      13
C                                                                      CORE      14
      COMMON/MDEC1/SIGMAX(200),SIGMIN(200)                             CORE      15
      COMMON/MSAL/RNCYC(200),KPMAX,IPRINT                              CORE      16
      DIMENSION PLSTRA(200), FN(200),AVSGMX(200),AVSGMN(200),EX(200),  CORE      17
     *ENNCYC(200),ASX(200),ASN(200),ASE(200)                           CORE      18
      COMMON/MCOR1/NLEVEL,IRPCM,IPLOT,ELMOD,TYS,EPSO,COFMAN,C1,E2,E1,  CORE      19
     *RES(200),AKT,SUMENN,SUMNC                                        CORE      20
      COMMON/MCOR2/STMIN(200),STMAX(200),ENN(200),A(10),B(10),C(10),   CORE      21
     *R(10),ISTEP(200),NN(200,10),IBLOCK(200)                          CORE      22
      JJ=KFL                                                           CORE      23
      IF(JJ.GT.3)IPRINT=3                                              CORE      24
      TRAIN=1                                                          CORE      25
      WRITE(6,54)JJ                                                    CORE      26
   54 FORMAT(20H FLIGHT OR BLOCK NO.,I5)                               CORE      27
      IF(IPRINT.GE.3) GO TO 51                                         CORE      28
      WRITE(6,62)                                                      CORE      29
   62 FORMAT(66H STMAX    STMIN    SIGMAX  SIGMIN   RES     EORES     ENNCORE      30
     *       NEP)                                                      CORE      31
   51 CONTINUE                                                         CORE      32
C                                                                      CORE      33
C                                                                      CORE      34
      KPLOT=1                                                          CORE      35
  148 DO 570 J=1,NLEVEL                                                CORE      36
  149 I=J+1                                                            CORE      37
      PLSTRA(J)=0.                                                     CORE      38
C                                                                      CORE      39
C       DETERMINE SEQUENCE ACCOUNTABLE RESIDUAL STRESS AND CORRESPONDINGCORE      40
C         PLASTIC STRAIN                                               CORE      41
C                                                                      CORE      42
  150 ASMAX=AKT*STMAX(J)                                               CORE      43
      ASMIN=AKT*STMIN(J)                                               CORE      44
        ASX(KPLOT)=ASMAX                                               CORE      45
      ASN(KPLOT)=ASMIN                                                 CORE      46
      ASE(KPLOT)=ENN(J)                                                CORE      47
      KPLOT=KPLOT+1                                                    CORE      48
      ASMEAN=(ASMAX+ASMIN)/2.                                          CORE      49
      JA=0                                                             CORE      50
  170 IF(RES(I-1)+ASMIN+TYS) 190,190,200                               CORE      51
  190 JA=1                                                             CORE      52
      AAA=RES(I-1)+ASMIN                                               CORE      53
      PLSTRA(J)=     -1.*(AAA/ELMOD)*(1.+AAA/TYS)                      CORE      54
  200 JB=0                                                             CORE      55
  202 IF(RES(I-1)+ASMAX-TYS) 220,210,210                               CORE      56
```

```
 210   JB=-1
       AAA=ASMAX
       BBB=TYS-RES(I-1)
       IF(BBB.GE.TYS) GO TO 214
 212   BBB=0.
 214   PLSTRA(J)=    AAA*AAA/(ELMOD*TYS)-BBB*BBB/(ELMOD*TYS)
 220   IF(JA+JB) 230,250,240
 230   RES(I)=TYS-ASMAX
       GO TO 290
 240   RES(I)=-TYS-ASMIN
       GO TO 290
 250   IF(JA) 260,260,270
 260   RES(I)=RES(I-1)
       GO TO 290
 270   RES(I)=-ASMEAN
 290   SIGMAX(IRAIN)=RES(I)+ASMAX
       SIGMIN(IRAIN)=RES(I)+ASMIN
       RNCYC(IRAIN)=ENN(J)
       IF(ASMAX.LE.TYS) GO TO 410
 400   EQRES=-ASMAX+TYS
       GO TO 440
 410   IF(ASMIN.GE.-TYS) GO TO 430
 420   EQRES=-ASMIN-TYS
       GO TO 440
 430   EQRES=0.
 440   DIF=RES(I)-EQRES
C
C        CALCULATE RELAXATION FUNCTION
C
       ABMAX=ABS(ASMAX)
       ABMIN=ABS(ASMIN)
       ABMEAN=ABS(ASMEAN)
        IF(ABMAX.LT.1.)ABMAX=1.
        IF(ABMEAN.LT.1.)ABMEAN=0.5
       IF(ABMIN-ABMAX) 444,444,442
 442   ABM=ABMIN
       GO TO 446
 444   ABM=ABMAX
 446   ENEP=C1/(ABM**E1*ABMEAN**E2)
       IF(IPRINT.GE.3)GO TO 351
       WRITE(6,350) STMAX(J),STMIN(J),SIGMAX(IRAIN),SIGMIN(IRAIN),
      *RES(I),EQRES,ENN(J),ENEP,J
 350    FORMAT(6(F7.2,1X),F6.2,1X,E15.8,5X,I6)
 351     CONTINUE
C
C        CALCULATE RESIDUAL STRESS RELAXATION
C
       IRAIN=IRAIN+1
       ABDIF=ABS(DIF)
       GO TO 350
       GO TO 550
 360   IF(ABDIF.LT.5.) GO TO 560
 370   IF(1000.*ENN(J).LT.ENEP) GO TO 560
        IF(ENN(J).LE.10.) GO TO 560
 380   NFLAG=0
```

```
      NFLAG2=10                                                          CORE   112
      IRAIN=IRAIN-1                                                      CORE   113
      DUMMY=ENN(J)                                                       CORE   114
  450 IF(DUMMY-ENEP) 470,460,460                                         CORE   115
  460 DUMMY=DUMMY/2.                                                     CORE   116
      NFLAG=NFLAG+1                                                      CORE   117
      GO TO 450                                                          CORE   118
  470 CYCINT=DUMMY/10.                                                   CORE   119
      DO 510 K=1,10                                                      CORE   120
      DECK=FLOAT(K)                                                      CORE   121
      EN(K)=CYCINT*DECK                                                  CORE   122
      IF(K.EQ.1) GO TO 490                                               CORE   123
  480 EX(K)=EXP(-2.303*EN(K-1)/ENEP)+EXP(-2.303*EN(K)/ENEP)              CORE   124
      GO TO 500                                                          CORE   125
  490 EX(K)=1.+EXP(-2.303*EN(K)/ENEP)                                    CORE   126
  500 CONTINUE                                                           CORE   127
      IF(NFLAG.EQ.0) GO TO 530                                           CORE   128
  510 NFLAG2=NFLAG+10                                                    CORE   129
      DO 520 K=11,NFLAG2                                                 CORE   130
      EN(K)=2.*DUMMY                                                     CORE   131
      EX(K)=EXP(-2.303*EN(K-1)/ENEP)+EXP(-2.303*EN(K)/ENEP)              CORE   132
      DUMMY=2.*DUMMY                                                     CORE   133
  520 CONTINUE                                                           CORE   134
  530 DO 559 K=1,NFLAG2                                                  CORE   135
      AVSGMX(K)=ASMAX+EQRES+DIF*EX(K)/2.                                 CORE   136
      AVSGMN(K)=AVSGMX(K)-ASMAX+ASMIN                                    CORE   137
      SIGMIN(IRAIN)=AVSGMN(K)                                            CORE   138
      SIGMAX(IRAIN)=AVSGMX(K)                                            CORE   139
      RNCYC(IRAIN)=EN(K)                                                 CORE   140
  545 IF(K.EQ.1) GO TO 543                                               CORE   141
  539 RNCYC(IRAIN)=RNCYC(IRAIN)-EN(K-1)                                  CORE   142
  540 IF(IPRINT.GE.3)GO TO 551                                           CORE   143
      WRITE(6,550) SIGMAX(IRAIN),SIGMIN(IRAIN),EN(K),RNCYC(IRAIN)        CORE   144
  550 FORMAT(16X,2(F7.2,1X),16X,F6.2,17X,F15.8)                          CORE   145
  551  CONTINUE                                                          CORE   146
      IRAIN=IRAIN+1                                                      CORE   147
  559  CONTINUE                                                          CORE   148
  560 CONTINUE                                                           CORE   149
      RES(I)=EQRES+DIF*EXP(-2.303*ENN(J)/ENEP)                           CORE   150
  570 CONTINUE                                                           CORE   151
  569 RES(1)=RES(J)                                                      CORE   152
      IN=IRAIN-1                                                         CORE   153
C                                                                        CORE   154
C     ******************************************************************* CORE   155
C                                                                        CORE   156
C                               MODULE III                               STD      2
C                       CYCLE COUNTING TECHNIQUE                         CORE   158
C                                                                        CORE   159
C     ******************************************************************* CORE   160
C                                                                        CORE   161
C       CALL SUBROUTINE TO RANGE PAIR COUNT SPECTRUM                     CORE   162
C                                                                        CORE   163
       IF(IRPCM.GT.1)GO TO 591                                           CORE   164
      CALL RPCM(IN)                                                      CORE   165
      GO TO 592                                                          CORE   166
```

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```
      591    CONTINUE                                                     CORE   167
             KPMAX=IN                                                     CORE   168
      592    CONTINUE                                                     CORE   169
      C                                                                   CORE   170
      C      ************************************************************ CORE   171
      C                                                                   CORE   172
      C                           MODULE IV                               STD      3
      C                  DAMAGE ACCUMULATION CALCULATION                  CORE   174
      C                                                                   CORE   175
      C      ************************************************************ CORE   176
      C                                                                   CORE   177
             IF(IPRINT.GE.3)GO TO 552                                     CORE   178
             WRITE(6,53)                                                  CORE   179
       53    FORMAT(//60H LOCAL STRESSES AND PLASTIC STRAINS W/RESULTING FATIGU CORE   180
            *E LIFE//10X,4HSTEP,10X,14HPLASTIC STRAIN,10X,10HMAX OR MIN,15X,6HD CORE   181
            *AMAGE)                                                       CORE   182
      552     CONTINUE                                                    CORE   183
      C                                                                   CORE   184
      C        CALCULATE DAMAGE FROM PLASTIC STRAIN CYCLES                CORE   185
      C                                                                   CORE   186
             SUMDEL=0.                                                    CORE   187
             DO 531 JKL=1,NLEVEL                                          CORE   188
             AA=1.                                                        CORE   189
             IF(PLSTRA(JKL)) 532,531,533                                  CORE   190
      532    AA=-1.                                                       CORE   191
      533    PLSTRA(JKL)=AA*PLSTRA(JKL)                                   CORE   192
             CYCLES=(PLSTRA(JKL)/EPSD)**COFMAN                            CORE   193
             DAM=1./CYCLES                                                CORE   194
             SUMNC=SUMNC+DAM                                              CORE   195
             SUMDEL=SUMDEL+DAM                                            CORE   196
             IF(IPRINT.GE.3) GO TO 531                                    CORE   197
             IF (AA) 535,535,537                                          CORE   198
      535    WRITE(6,199)JKL,PLSTRA(JKL),DAM                              CORE   199
      199    FORMAT(10X,I4,12X,F10.5,15X,3HMIN,15X,E14.6)                 CORE   200
              GO TO 531                                                   CORE   201
      537    WRITE(6,219)JKL,PLSTRA(JKL),DAM                              CORE   202
      219    FORMAT(10X,I4,12X,F10.5,15X,3HMAX,15X,E14.6)                 CORE   203
      531    CONTINUE                                                     CORE   204
             WRITE(6,541) SUMDEL                                          CORE   205
      541    FORMAT(59X,29H DAMAGE FROM PLASTIC STRAINS=,E15.8)           CORE   206
             IF(IPRINT.GE.3) GO TO 536                                    CORE   207
             WRITE(6,13)                                                  CORE   208
       13    FORMAT(/16X,15H SIGMAX  SIGMIN,18X,6H RNCYC,20X,25H CYCLES   CORE   209
            *   ENN/CYC)                                                  CORE   210
      536    CONTINUE                                                     CORE   211
      C                                                                   CORE   212
      C        CALCULATE ELASTIC CYCLE DAMAGE FROM LEAST SQUARE FITTED S-N DATA CORE   213
      C            (MODIFIED GOODMAN DIAGRAM FORMAT)                      CORE   214
      C                                                                   CORE   215
             DO 600 JKL=1,KPMAX                                           CORE   216
      534    TTYS=TYS/5.                                                  CORE   217
             X=SIGMIN(JKL)                                                CORE   218
             Y=SIGMAX(JKL)                                                CORE   219
             IF(Y-X.LT.1.6*TYS) GO TO 310                                 CORE   220
             CYCLES=10.**4.                                               CORE   221
```

```
      GO TO 340
 310  IF(Y.GE.TTYS) GO TO 320
 347  CYCLES=10.**9.
       GO TO 340
 320  N=4
      DO 330 M=1,4
      R(N)=A(N)*X**2+B(N)*X+C(N)-Y
      N=N+1
 330  CONTINUE
 332  IF(R(7)*R(4)) 339,338,334
 334  ABR7=ABS(R(7))
      ABR4=ABS(R(4))
      IF(ABR7.LE.ABR4 ) GO TO 335
 335  EXPO=4.+R(4)/(R(4)-R(5))
      GO TO 339
 336  EXPO=7.+R(7)/(R(6)-R(7))
      GO TO 339
 338  SUMR=R(4)+R(5)+R(6)+R(7)
      SUMR2=R(4)**2+R(5)**2+R(6)**2+R(7)**2
      SUMR3=R(4)**3+R(5)**3+R(6)**3+R(7)**3
      SUMR4=R(4)**4+R(5)**4+R(6)**4+R(7)**4
      SUMRN=4.*R(4)+5.*R(5)+6.*R(6)+7.*R(7)
      SUMR2N=4.*R(4)**2+5.*R(5)**2+6.*R(6)**2+7.*R(7)**2
      DEL1=4.*SUMR2*SUMR4-4.*SUMR3**2
      DEL2=SUMR*SUMR2*SUMR3-SUMR4*SUMR**2
      DEL3=SUMR*SUMR2*SUMR3-SUMR2**3
      DO1=22.*SUMR2*SUMR4-22.*SUMR3**2
      DO2=SUMR2*SUMR3*SUMRN-SUMR*SUMR4*SUMRN
      DO3=SUMR*SUMR3*SUMR2N-SUMR2N*SUMR2**2
      EXPO=(DO1+DO2+DO3)/(DEL1+DEL2+DEL3)
 339  CYCLES=10.**EXPO
      IF(EXPO.LE.4.)CYCLES=10.**4.
 340  ENNCYC(JKL)=RNCYC(JKL)/CYCLES
      SUMNC=SUMNC+ENNCYC(JKL)
       SUMDEL=SUMDEL+ENNCYC(JKL)
      IF(IPRINT.GE.3)GO TO 600
      WRITE(6,599) Y,X,RNCYC(JKL),CYCLES,ENNCYC(JKL)
 599   FORMAT(16X,2(F7.2,1X),16X,F6.0,17X,2(E15.8,1X))
 600  CONTINUE
      WRITE(6,593)SUMDEL
 593  FORMAT(/69X,21H DAMAGE PER THIS SET=,E15.3)
      WRITE(6,575) SUMNC
 575  FORMAT(/69X,18H  TOTAL ENN/CYC =,E15.8)
      END
```

```
      SUBROUTINE RPCM(NPKS)                                             CORE     266
C                                                                       CORE     267
C     THIS PROGRAM EMPLOYS THE RANGE PAIR CYCLE COUNTING METHOD TO GENER CORE    268
C     ANALYSIS SPECTRUM FROM A GIVEN LOAD SPECTRUM                      CORE     269
C                                                                       CORE     270
C                                                                       CORE     271
C                                PROGRAM ARRAYS                         CORE     272
C                     (INFORMATION NEEDED TO CHANGE DIMENSIONS)         CORE     273
C                                                                       CORE     274
C     ARRAY NAME             DEFINITION                   DIMENSION    CORE     275
C       SIGMAX      PEAKS OF THE INPUT LOAD SPECTRUM       NPKS + KK    CORE     276
C              KK = THE NUMBER OF ADDITIONAL CYCLES (EXCLUDING INPUT CYCL CORE   277
C                   WHICH THE PROGRAM WILL GENERATE                     CORE     278
C       SIGMIN      VALLEYS OF THE INPUT LOAD SPECTRUM     NPKS + KK    CORE     279
C       RNCYC       K COUNTERS OF THE PEAKS AND VALLEYS    NPKS + KK    CORE     280
C       NSTEP       STEP NUMBERS OF THE INPUT SPECTRUM     NPKS + KK    CORE     281
C       RES         RESIDUE SPECTRUM                        2*NPKS      CORE     282
C       INDEX       STEP NUMBERS OF ELEMENTS IN RES         2*NPKS      CORE     283
C       CYCLE       RANGE PAIR COUNTED CYCLES              NPKS + KK    CORE     284
C       RNECYC      K COUNTERS OF THE CYCLES OF THE        NPKS + KK    CORE     285
C                   UNSORTED ANALYSIS SPECTRUM                          CORE     286
C       NNSTEP      STEP NUMBERS OF ELEMENTS OF THE        NPKS + KK    CORE     287
C                   UNSORTED ANALYSIS SPECTRUM                          CORE     288
C       ISAVE       VALUES OF NSTEP(J) SUCH THAT RNCYC(J)      99       CORE     289
C                   IS < 1.0 AND VALUES OF NSTEP(J) SUCH                CORE     290
C                   THAT SIGMAX(J-1) = SIGMAX(J) AND                    CORE     291
C                   SIGMIN(J-1) = SIGMIN(J)                             CORE     292
C                                                                       CORE     293
C                                                                       CORE     294
      COMMON/MSAL/RNCYC(200),KPMAX,IPRINT                               CORE     295
      COMMON/MDEC1/SIGMAX(200),SIGMIN(200)                              CORE     296
      COMMON/MDEC2/NSTEP(900),LR,KMAX,KMIN,K31                          CORE     297
      COMMON/MDECR/RES(1400),INDEX(1400),IND1,IND2,IND3,IND4,KIND       CORE     298
      COMMON/MCYC/CYCLE(900,2),RNECYC(900),NNSTEP(900)                  CORE     299
      COMMON/MCGDE/L,LIND                                               CORE     300
      DIMENSION ISAVE(99),TITLE(8)                                      CORE     301
 9999 NPUNCH = 0                                                        CORE     302
      DO 8000 I = 1,NPKS                                                CORE     303
 8000 NSTEP(I) = I                                                      CORE     304
      IF(IPRINT.GE.2)GO TO 103                                          CORE     305
      WRITE(6,20) NPKS                                                  CORE     306
   20 FORMAT(1H0,60HTHE NUMBER OF PEAKS OR VALLEYS IN THE INPUT LOAD SPE CORE    307
     1CTRUM = ,I5//)                                                    CORE     308
      WRITE(6,22)                                                       CORE     309
   22 FORMAT(60X,5HSIGMA/31X,4HSTEP,13X,7HMAXIMUM,16X,7HMINIMUM,13X,    CORE     310
     1        9HCOUNTER K/)                                             CORE     311
      WRITE(6,25) (NSTEP(I),SIGMAX(I),SIGMIN(I),RNCYC(I), I = 1,NPKS)   CORE     312
   25 FORMAT(29X,I5,10X,E13.6,10X,E13.6,10X,F10.5)                      CORE     313
  103  CONTINUE                                                         CORE     314
C                                                                       CORE     315
C     SORT THROUGH THE LOAD SPECTRUM - PULL OUT THOSE PEAKS AND VALLEYS CORE     316
C     COUNTER K IS LESS THAN 1.0                                        CORE     317
C                                                                       CORE     318
      J = 1                                                             CORE     319
      L = 0                                                             CORE     320
```

```
      NRPS = 1                                                          CORE  321
      RCYNO = 100                                                       CORE  322
      JMAX = 0                                                          CORE  323
      DO 100 I = 1,NPKS                                                 CORE  324
      IF (RNCYC(I) .GE. 1.0) GO TO 100                                  CORE  325
      X1 = SIGMAX(I)                                                    CORE  326
      X2 = SIGMIN(I)                                                    CORE  327
      CALL CYCGEN(X1,X2  ,RNCYC(I),NSTEP(I))                            CORE  328
      ISAVE(J) = I                                                      CORE  329
      J = J + 1                                                         CORE  330
  100 CONTINUE                                                          CORE  331
      JMAX = J - 1                                                      CORE  332
      NPKSN = NPKS - JMAX                                               CORE  333
      IF (JMAX .EQ. 0) GO TO 200                                        CORE  334
      WRITE(6,23) (ISAVE(K), K = 1,JMAX)                                CORE  335
      IF(IPRINT.GE.2)GO TO 101                                          CORE  336
   23 FORMAT(1H0,33HSTEP NUMBERS OF THOSE PEAKS AND VALLEYS IN THE LOAD CORE  337
     1SPECTRUM WHOSE COUNTER K IS LESS THAN 1.0//(17I7))                CORE  338
  101 CONTINUE                                                          CORE  339
      DO 110 J = 1,JMAX                                                 CORE  340
      I = ISAVE(J) - (J-1)                                              CORE  341
      NPKN = NPKS - J                                                   CORE  342
      IF (I .EQ. NPKN) GO TO 110                                        CORE  343
      DO 115 II = I,NPKN                                                CORE  344
      SIGMAX(II) = SIGMAX(II+1)                                         CORE  345
      SIGMIN(II) = SIGMIN(II+1)                                         CORE  346
      NSTEP(II) = NSTEP(II+1)                                           CORE  347
      RNCYC(II) = RNCYC(II+1)                                           CORE  348
  115 CONTINUE                                                          CORE  349
  110 CONTINUE                                                          CORE  350
  200 CONTINUE                                                          CORE  351
C                                                                       CORE  352
C     SORT THROUGH THE LOAD SPECTRUM DATA - COMBINE STEPS WITH IDENTICAL CORE  353
C     AND VALLEYS WHICH OCCUR CONSECUTIVELY                             CORE  354
C                                                                       CORE  355
      J = 1                                                             CORE  356
      DO 300 I = 2,NPKSN                                                CORE  357
      IF (SIGMAX(I) .NE. SIGMAX(I-1)) GO TO 300                         CORE  358
      IF (SIGMIN(I) .NE. SIGMIN(I-1)) GO TO 300                         CORE  359
      ISAVE(J) = I                                                      CORE  360
      RNCYC(I-1) = RNCYC(I-1) + RNCYC(I)                                CORE  361
      J = J + 1                                                         CORE  362
  300 CONTINUE                                                          CORE  363
      IF (J .EQ. 1) GO TO 6000                                          CORE  364
      JMAS = J - 1                                                      CORE  365
      DO 311 J = 1,JMAS                                                 CORE  366
      I = ISAVE(J) - (J-1)                                              CORE  367
      NPKN = NPKSN - J                                                  CORE  368
      IF (I .EQ. NPKN) GO TO 311                                        CORE  369
      DO 316 II = I,NPKN                                                CORE  370
      SIGMAX(II) = SIGMAX(II+1)                                         CORE  371
      SIGMIN(II) = SIGMIN(II+1)                                         CORE  372
      NSTEP(II) = NSTEP(II+1)                                           CORE  373
      RNCYC(II) = RNCYC(II+1)                                           CORE  374
  316 CONTINUE                                                          CORE  375
```

```
      311 CONTINUE                                          CORE     376
          NPKSN = NPKSN - JMAS                              CORE     377
C                                                           CORE     378
C         RANGE PAIR COUNT THE ADJUSTED LOAD SPECTRUM       CORE     379
C                                                           CORE     380
     6000 I = 1                                             CORE     381
          KB = 0                                            CORE     382
          L = JMAX                                          CORE     383
          KMIN = 0                                          CORE     384
          KMAX = 0                                          CORE     385
          LR = 0                                            CORE     386
          K31 = 0                                           CORE     387
        1 IF (RNCYC(I) .GT. 1.0) GO TO 400                  CORE     388
          IF (KB .NE. 0) GO TO 5                            CORE     389
          X1 = SIGMAX(I)                                    CORE     390
          X2 = SIGMIN(I)                                    CORE     391
          IND1 = NSTEP(I)                                   CORE     392
          IND2 = IND1                                       CORE     393
          I = I + 1                                         CORE     394
          KB = 1                                            CORE     395
          GO TO 1                                           CORE     396
        5 X3 = SIGMAX(I)                                    CORE     397
          X4 = SIGMIN(I)                                    CORE     398
          IND3 = NSTEP(I)                                   CORE     399
          IND4 = IND3                                       CORE     400
          KMIN = 1                                          CORE     401
          KMAX = 0                                          CORE     402
          K31 = 0                                           CORE     403
          IF (RNCYC(I) .EQ. 1.0) GO TO 6                    CORE     404
          KEY = 1                                           CORE     405
          KIND = 1                                          CORE     406
          GO TO 415                                         CORE     407
        6 KEY = 0                                           CORE     408
          CYCNO = AINT(RNCYC(I)+0.5)                        CORE     409
          CALL DECIDE(X1,X2,X3,X4,KEY,I,CYCNO,KCYGEN)       CORE     410
     1000 GO TO (10,10,30),KCYGEN                           CORE     411
       10 KB = 1                                            CORE     412
          I = I + 1                                         CORE     413
          IF (KMIN .NE. 1) GO TO 36                         CORE     414
          IF (I .LE. NPKSN) GO TO 5                         CORE     415
          RES(LR+1) = X1                                    CORE     416
          RES(LR+2) = X2                                    CORE     417
          INDEX(LR+1) = IND1                                CORE     418
          INDEX(LR+2) = IND2                                CORE     419
          LRMAX = LR + 2                                    CORE     420
          GO TO 2000                                        CORE     421
       30 IF (KMIN .NE. 1) GO TO 35                         CORE     422
       12 I = I + 1                                         CORE     423
          IF (I .LE. NPKSN) GO TO 31                        CORE     424
          RES(LR+1) = X1                                    CORE     425
          RES(LR+2) = X2                                    CORE     426
          RES(LR+3) = X3                                    CORE     427
          INDEX(LR+1) = IND1                                CORE     428
          INDEX(LR+2) = IND2                                CORE     429
          INDEX(LR+3) = IND3                                CORE     430
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      LRMAX = LR + 3                                    CORE    431
      GO TO 2000                                        CORE    432
   31 X4 = SIGMAX(I)                                    CORE    433
      IND4 = NSTEP(I)                                   CORE    434
      KMAX = 1                                          CORE    435
      KMIN = 0                                          CORE    436
      K31 = 1                                           CORE    437
   32 IF (RNCYC(I) .GT. 1.0) GO TO 40                   CORE    438
      GO TO 5                                           CORE    439
   40 KEY = 1                                           CORE    440
      KIND = 0                                          CORE    441
      GO TO 415                                         CORE    442
   35 X4 = SIGMIN(I)                                    CORE    443
      IND4 = NSTEP(I)                                   CORE    444
      KMIN = 1                                          CORE    445
      KMAX = 0                                          CORE    446
      K31 = 0                                           CORE    447
      GO TO 32                                          CORE    448
   36 X3 = SIGMIN(I)                                    CORE    449
      IND3 = NSTEP(I)                                   CORE    450
      KMIN = 1                                          CORE    451
      KMAX = 0                                          CORE    452
      GO TO 12                                          CORE    453
  400 KEY = 1                                           CORE    454
      IF (K3 .NE. 0) GO TO 410                          CORE    455
      X1 = SIGMAX(I)                                    CORE    456
      X2 = SIGMIN(I)                                    CORE    457
      X3 = SIGMAX(I)                                    CORE    458
      X4 = SIGMIN(I)                                    CORE    459
      IND1 = NSTEP(I)                                   CORE    460
      IND2 = IND1                                       CORE    461
      IND3 = IND1                                       CORE    462
      IND4 = IND1                                       CORE    463
      KMIN = 1                                          CORE    464
      KMAX = 0                                          CORE    465
      K31 = 0                                           CORE    466
      IF (RNCYC(I) .LE. 2.0) GO TO 401                  CORE    467
      RNCYC(I) = RNCYC(I) - 1.0                         CORE    468
      GO TO 402                                         CORE    469
  401 RNCYC(I) = RNCYC(I) - 2.0                         CORE    470
  402 KIND = 0                                          CORE    471
      GO TO 415                                         CORE    472
  410 X3 = SIGMAX(I)                                    CORE    473
      X4 = SIGMIN(I)                                    CORE    474
      IND3 = NSTEP(I)                                   CORE    475
      IND4 = IND3                                       CORE    476
      KMIN = 1                                          CORE    477
      KMAX = 0                                          CORE    478
      K31 = 0                                           CORE    479
      KIND = 1                                          CORE    480
      RNCYC(I) = RNCYC(I) - 1.0                         CORE    481
      K3 = 0                                            CORE    482
  415  CYCNO = AINT(RNCYC(I)+0.5)                       CORE    483
      CALL DECIDE(X1,X2,X3,X4,KEY,I,CYCNO,KCYGEN)       CORE    484
      GO TO 1000                                        CORE    485
```

28

```
 2000 LMAX = L                                                         CORE   486
      IF (LRMAX .LT. 4) GO TO 5000                                     CORE   487
      IF (NCYNO .EQ. 0) GO TO 5000                                     CORE   488
C                                                                      CORE   489
C     RANGE PAIR COUNT OF RESIDUE SPECTRUMS                            CORE   490
C                                                                      CORE   491
      NRES = NRES + 1                                                  CORE   492
      CALL DECRES(LRMAX,NCYNO)                                         CORE   493
      GO TO 2000                                                       CORE   494
 5000 IF (LRMAX .LE. 1) GO TO 3000                                     CORE   495
C                                                                      CORE   496
C     COUNT THE LAST RESIDUE SPECTRUM - RANGE PAIR COUNTING WILL YIELD N CORE 497
C     ADDITIONAL CYCLES                                                CORE   498
C                                                                      CORE   499
      KK = 0                                                           CORE   500
      RESMAX = RES(1)                                                  CORE   501
      RESMIN = RES(1)                                                  CORE   502
      IMAX = 1                                                         CORE   503
      IMIN = 1                                                         CORE   504
      DO 500 I = 2,LRMAX                                               CORE   505
      IF (RES(I) .LT. RESMAX) GO TO 490                                CORE   506
      RESMAX = RES(I)                                                  CORE   507
      IMAX = I                                                         CORE   508
      GO TO 500                                                        CORE   509
  490 IF (RES(I) .GT. RESMIN) GO TO 500                                CORE   510
      RESMIN = RES(I)                                                  CORE   511
      IMIN = I                                                         CORE   512
  500 CONTINUE                                                         CORE   513
      CALL CYCRES(RESMAX,RESMIN,1.0,INDEX(IMAX))                       CORE   514
      KK = KK + 1                                                      CORE   515
  510 J = IMAX - 2                                                     CORE   516
      IF (J .LE. 0) GO TO 550                                          CORE   517
      CALL CYCRES(RES(J),RES(J+1),1.0,INDEX(J))                        CORE   518
      KK = KK + 1                                                      CORE   519
      IMAX = J                                                         CORE   520
      GO TO 510                                                        CORE   521
  550 J = IMIN + 2                                                     CORE   522
      IF (J .GT. LRMAX) GO TO 575                                      CORE   523
      CALL CYCRES(RES(J-1),RES(J),1.0,INDEX(J-1))                      CORE   524
      KK = KK + 1                                                      CORE   525
      IMIN = J                                                         CORE   526
      GO TO 550                                                        CORE   527
  575 KMAX = KK                                                        CORE   528
      LMAX = L                                                         CORE   529
C                                                                      CORE   530
C     SORT THE ANALYSIS SPECTRUM TO PRODUCE THE RANGE PAIR COUNTED SPECT CORE 531
C                                                                      CORE   532
 3000 KP = 0                                                           CORE   533
      DO 605 JJ = 1,NPKS                                               CORE   534
      KC = 0                                                           CORE   535
      DO 600 I = 1,LMAX                                                CORE   536
      IF (NNSTEP(I) .NE. JJ) GO TO 600                                 CORE   537
      KP = KP + 1                                                      CORE   538
      KC = KC + 1                                                      CORE   539
      NSTEP(KP) = KP                                                   CORE   540
```

```
      SUBROUTINE DECIS(X1,X2,X3,X4,KEY,I,CYCNO,KCYGEN)               CORE  581
      COMMON/MDEC1/SIGMAX(200),SIGMIN(200)                           CORE  582
      COMMON/MDEC2/NSTEP(900),LR,KMAX,KMIN,K31                       CORE  583
      COMMON/MDECR/RES(1400),INDEX(1400),IND1,IND2,IND3,IND4,KIND    CORE  584
      COMMON/MCYG/CYCLE(900,2),RNEGYC(900),NNSTEP(900)               CORE  585
      COMMON/MCGDE/L,LIND                                            CORE  586
C                                                                    CORE  587
C     THIS SUBROUTINE DECIDES WHETHER OR NOT THE VALUES X1,X2,X3, AND X4 CORE  588
C     FROM THE ADJUSTED LOAD SPECTRUM SATISFY THE RANGE PAIR COUNTING CO CORE  589
C                                                                    CORE  590
      KFIRST = 0                                                     CORE  591
      IF (K31 .NE. 0) GO TO 11                                       CORE  592
   10 IF (X3 .LE. X2) GO TO 200                                      CORE  593
   11 IF (X2 .GT. X1) GO TO 210                                      CORE  594
      IF (X2 .LT. X4 .OR. X3 .GT. X1) GO TO 500                      CORE  595
  150 IF (X2 .GT. X3) GO TO 151                                      CORE  596
      CALL CYCGEN(X3,X2,1.0,NSTEP(I))                                CORE  597
      GO TO 152                                                      CORE  598
  151 CALL CYCGEN(X2,X3,  1.0,NSTEP(I))                              CORE  599
  152 X1 = X1                                                        CORE  600
      X2 = X4                                                        CORE  601
      IF (IND3 .NE. IND2) LIND = 1                                   CORE  602
      IND2 = IND4                                                    CORE  603
      KCYGEN = 1                                                     CORE  604
      IF (KEY .NE. 0) GO TO 110                                      CORE  605
      RETURN                                                         CORE  606
  210 IF (X2 .GT. X4 .OR. X3 .LT. X1) GO TO 500                      CORE  607
      GO TO 150                                                      CORE  608
  200 X1 = X1                                                        CORE  609
      X2 = X4                                                        CORE  610
      IND2 = IND4                                                    CORE  611
      KCYGEN = 2                                                     CORE  612
      IF (KEY .EQ. 0) RETURN                                         CORE  613
      CYCNO = CYCNO - 1.0                                            CORE  614
      GO TO 110                                                      CORE  615
C                                                                    CORE  616
C     ADD X1 TO THE RESIDUE SPECTRUM                                 CORE  617
C                                                                    CORE  618
  500 LR = LR + 1                                                    CORE  619
      RES(LR) = X1                                                   CORE  620
      INDEX(LR) = IND1                                               CORE  621
      X1 = X2                                                        CORE  622
      X2 = X3                                                        CORE  623
      X3 = X4                                                        CORE  624
      IND1 = IND2                                                    CORE  625
      IND2 = IND3                                                    CORE  626
      IND3 = IND4                                                    CORE  627
      KCYGEN = 3                                                     CORE  628
      IF (KEY .NE. 0) GO TO 110                                      CORE  629
      RETURN                                                         CORE  630
  110 GO TO (1150,1200,1500),KCYGEN                                  CORE  631
 1150 IF (CYCNO .GT. 1.0) GO TO 1151                                 CORE  632
      IF (CYCNO .EQ. 0.0) RETURN                                     CORE  633
 1153 CYCNO = CYCNO - 1.0                                            CORE  634
      GO TO 1152                                                     CORE  635
```

32

```
 1151 IF (LIND .EQ. 1) GO TO 1153                          CORE   636
      IF (IND3 .NE. IND4) GO TO 1153                       CORE   637
      RNECYC(L) = RNECYC(L) + CYCNO - 2.0                  CORE   638
      CYCNO = 1.0                                          CORE   639
 1152 IF (KMAX .NE. 1) GO TO 111                           CORE   640
      X3 = SIGMIN(I)                                       CORE   641
      IND3 = NSTEP(I)                                      CORE   642
      IF (CYCNO .NE. 0.0) GO TO 112                        CORE   643
      KMIN = 1                                             CORE   644
      KMAX = 0                                             CORE   645
      KCYGEN = 3                                           CORE   646
      RETURN                                               CORE   647
 1200 IF (CYCNO .EQ. 0.0) RETURN                           CORE   648
      CYCNO = CYCNO - 1.0                                  CORE   649
      X3 = SIGMAX(I)                                       CORE   650
      X4 = SIGMIN(I)                                       CORE   651
      KFIRST = 1                                           CORE   652
      GO TO 113                                            CORE   653
  111 X3 = SIGMAX(I)                                       CORE   654
      X4 = SIGMIN(I)                                       CORE   655
      IF (KFIRST .NE. 0) GO TO 113                         CORE   656
      CYCNO = CYCNO - 1.0                                  CORE   657
      KFIRST = 1                                           CORE   658
  113 IND3 = NSTEP(I)                                      CORE   659
      IND4 = IND3                                          CORE   660
      KMIN = 1                                             CORE   661
      KMAX = 0                                             CORE   662
      GO TO 11                                             CORE   663
 1500 IF (KMAX .NE. 0) GO TO 1510                          CORE   664
      IF (CYCNO .EQ. 0.0) RETURN                           CORE   665
      CYCNO = CYCNO - 1.0                                  CORE   666
  112 X4 = SIGMAX (I)                                      CORE   667
      IND4 = NSTEP(I)                                      CORE   668
      KMAX = 1                                             CORE   669
      KMIN = 0                                             CORE   670
      GO TO 11                                             CORE   671
 1510 X4 = SIGMIN(I)                                       CORE   672
      IND4 = NSTEP(I)                                      CORE   673
      KMAX = 0                                             CORE   674
      KMIN = 1                                             CORE   675
      GO TO 10                                             CORE   676
      END                                                  CORE   677
```

```
      SUBROUTINE DECRES(LRMAX,NOYND)                                    CORE  678
      COMMON/MOGDE/L,LIND                                               CORE  679
      COMMON/MDECR/RES(1400),INDEX(1400),IND1,IND2,IND3,IND4,KIND       CORE  680
C                                                                       CORE  681
C     THIS SUBROUTINE DECIDES WHETHER OR NOT THE ELEMENTS OF THE RESIDUE CORE  682
C     SPECTRUM SATISFY THE RANGE PAIR COUNTING CONDITIONS               CORE  683
C                                                                       CORE  684
      K = 0                                                             CORE  685
      NOYND = 0                                                         CORE  686
      X1 = RES(1)                                                       CORE  687
      X2 = RES(2)                                                       CORE  688
      X3 = RES(3)                                                       CORE  689
      X4 = RES(4)                                                       CORE  690
      IND1 = INDEX(1)                                                   CORE  691
      IND2 = INDEX(2)                                                   CORE  692
      IND3 = INDEX(3)                                                   CORE  693
      IND4 = INDEX(4)                                                   CORE  694
      J = 4                                                             CORE  695
   10 IF (X2 .GT. X1) GO TO 100                                         CORE  696
      IF (X2 .LT. X4 .OR. X3 .GT. X1) GO TO 500                         CORE  697
  150 IF (X2 .GT. X3) GO TO 151                                         CORE  698
      CALL CYCRES(X3,X2,1.0,IND3)                                       CORE  699
      GO TO 152                                                         CORE  700
  151 CALL CYCRES(X2,X3,1.0,IND2)                                       CORE  701
  152 NOYND = NOYND + 1                                                 CORE  702
      X1 = X1                                                           CORE  703
      X2 = X4                                                           CORE  704
      IND2 = IND4                                                       CORE  705
      IF (J .EQ. LRMAX) GO TO 300                                       CORE  706
      IF ((J + 1) .EQ. LRMAX) GO TO 315                                 CORE  707
      X3 = RES(J+1)                                                     CORE  708
      X4 = RES(J+2)                                                     CORE  709
      IND3 = INDEX(J+1)                                                 CORE  710
      IND4 = INDEX(J+2)                                                 CORE  711
      J = J+2                                                           CORE  712
      GO TO 10                                                          CORE  713
  100 IF (X2 .GT. X4 .OR. X3 .LT. X1) GO TO 500                         CORE  714
      GO TO 150                                                         CORE  715
  500 K = K + 1                                                         CORE  716
      RES(K) = X1                                                       CORE  717
      INDEX(K) = IND1                                                   CORE  718
      J = J + 1                                                         CORE  719
      IF (J .GT. LRMAX) GO TO 330                                       CORE  720
      X1 = X2                                                           CORE  721
      X2 = X3                                                           CORE  722
      X3 = X4                                                           CORE  723
      X4 = RES(J)                                                       CORE  724
      IND1 = IND2                                                       CORE  725
      IND2 = IND3                                                       CORE  726
      IND3 = IND4                                                       CORE  727
      IND4 = INDEX(J)                                                   CORE  728
      GO TO 10                                                          CORE  729
  300 K = K + 1                                                         CORE  730
      RES(K) = X1                                                       CORE  731
      RES(K+1) = X2                                                     CORE  732
```

34

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      INDEX(K) = IND1                                    CORE   733
      INDEX(K+1) = IND2                                  CORE   734
      LRMAX = K + 1                                      CORE   735
      RETURN                                             CORE   736
  315 K = K + 1                                          CORE   737
      RES(K) = X1                                        CORE   738
      RES(K+1) = X2                                      CORE   739
      RES(K+2) = RES(J+1)                                CORE   740
      INDEX(K) = IND1                                    CORE   741
      INDEX(K+1) = IND2                                  CORE   742
      INDEX(K+2) = INDEX(J+1)                            CORE   743
      LRMAX = K + 2                                      CORE   744
      RETURN                                             CORE   745
  330 K = K + 1                                          CORE   746
      RES(K) = X2                                        CORE   747
      RES(K+1) = X3                                      CORE   748
      RES(K+2) = X4                                      CORE   749
      INDEX(K) = IND2                                    CORE   750
      INDEX(K+1) = IND3                                  CORE   751
      INDEX(K+2) = IND4                                  CORE   752
      LRMAX = K + 2                                      CORE   753
      RETURN                                             CORE   754
      END                                                CORE   755
```

```
      SUBROUTINE CYCRES(Y1,Y2,  CYCPF,NSTEPP)                           CORE     756
      COMMON/MCYC/CYCLE(900,2),RNECYC(900),NNSTEP(900)                  CORE     757
      COMMON/MCGDE/L,LINO                                               CORE     758
C                                                                       CORE     759
C     THIS SUBROUTINE GENERATES CYCLES FOR THE ANALYSIS SPECTRUM FROM DA CORE     760
C     SUPPLIED BY SUBROUTINE DECRES                                     CORE     761
C                                                                       CORE     762
      L = L + 1                                                         CORE     763
      CYCLE(L,1) = Y1                                                   CORE     764
      CYCLE(L,2) = Y2                                                   CORE     765
      RNECYC(L) = CYCPF                                                 CORE     766
      NNSTEP(L) = NSTEPP                                                CORE     767
      RETURN                                                            CORE     768
      END                                                               CORE     769
```

APPENDIX II

SAMPLE PROBLEM WITH INPUT DATA LISTING

```
1 DATA DECKS ARE TO EE PROCESSED.

SPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE
SEQUENCE ACCOUNTABLE FATIGUE EVALUATION
```

SPECTRUM FROM B-1 SPECTRUM -- TRUNCATION LEVEL 27[illegible].[illegible]00 CYCLES
MATERIAL TYPE -- 2219-T851 AL

TENSILE YIELD STRESS (KSI) -- 55.00000

LCF STRAIN INTERCEPT = .40000

INVERSE OF COFFIN-MANSON SLOPE -1.83500

ELASTIC MODULUS = 10000.00000

COEFFICIENTS OF SECOND ORDER LEAST SQUARE FIT OF S-N DATA
SMAX = A(I)*SMIN**2 + B(I)*SMIN + C(I)

LIFE	A(I)	B(I)	C(I)
10** 4	-.00217	.22941	55.82462
10** 5	-.00178	.33210	48.26657
10** 6	-.00149	.46283	39.66455
10** 7	-.00243	.64199	31.70955

UNNOTCHED COUPON S-N DATA DERIVED FROM
INFORMATION SUPPLIED FROM NORTH AMERICAN

RESIDUAL STRESS RELAXATION FUNCTION

ENEP = C1/(KTSMAX**E1 * KTSMEAN**E2)
WHERE C1 = .25000000E+07 , E1 = 1.000 AND E2 = 1.000

7 TIMES THROUGH BLOCK OF 44 LOADS

LOAD LIMIT = 26.90000

STEP	TYPE	STMIN	STMAX	ENN
1	1	-.14800	-.02900	1.00000
2	3	.58400	1.00000	1.00000
3	2	.58400	.89500	1.00000
4	1	.58400	.68400	1.00000
5	1	.45500	.58400	1.00000
6	1	.64800	.69300	1.00000
7	1	.39500	.69900	1.00000
8	1	.48800	.56300	3.00000
9	1	.23500	.50900	1.00000
10	1	.50900	.62700	2.00000
11	1	.43400	.50900	1.00000
12	1	.36400	.69000	1.00000
13	1	.13300	.36400	1.00000
14	1	.36400	.48200	6.00000
15	1	.30400	.36400	1.00000
16	1	.30700	.75600	1.00000
17	1	.31600	.52700	1.00000
18	2	.54500	.70800	1.00000
19	1	.33400	.61700	1.00000
20	1	.40100	.51200	7.00000
21	1	.12700	.54800	1.00000
22	1	.22900	.37700	48.00000
23	1	-.00600	.34000	1.00000
24	1	.13000	.24400	35.00000
25	1	.07800	.72300	1.00000
26	1	.11100	.55700	9.00000
27	1	.18700	.37700	10.00000
28	3	.52700	.99100	1.00000
29	2	-.12000	.88300	1.00000

30	1	.52700	.74700	1.00000
31	1	-.14800	-.02900	1.00000
32	1	.55700	.84600	1.00000
33	1	.50900	.88000	1.00000
34	1	.33100	.52700	1.00000
35	1	.52700	.61700	19.00000
36	1	.46400	.52700	2.00000
37	1	.48200	.81000	1.00000
38	1	.58100	.68700	1.00000
39	1	.32200	.70200	1.00000
40	1	.39500	.44900	9.00000
41	1	.43100	.59000	5.00000
42	1	.46100	.54500	29.00000
43	1	-.14800	-.02900	1.00000
44	1	-.13600	-.03900	1.00000

BLOCK	TYPE	TYPE	TYPE	TYPE	TYPE	TYPE	TYPE	TYPE
1	1	-0	-0					
2	1	-0	-0					
3	2	1	-0					
4	1	-0	-0					
5	3	1	-0					
6	1	-0	-0					
7	1	-0	-0					

SPECTRUM FROM B-1 SPECTRUM -- TRUNCATION LEVEL 270,000 CYCLES

AKT = 4.90

RELAXATION CONSTANT CTA 2500000.00

SPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE

FLIGHT OR BLOCK NO. 1

STMAX	STMIN	SIGMAX	SIGMIN	RES	EQRES	ENN	NEP	
-.78	-3.98	-3.51	-17.92	0.00	0.00	1.00	.13025831E+05	1
18.40	15.71	55.00	42.89	-27.80	-27.80	1.00	.39342782E+03	2
15.71	12.24	42.89	27.20	-27.80	-15.69	1.00	.56235689E+03	3
18.64	17.43	55.00	49.55	-28.89	-28.89	1.00	.36717948E+03	4
18.80	10.63	55.00	18.23	-29.61	-29.61	1.00	.44621680E+03	5
15.14	13.13	38.54	29.46	-29.61	-13.15	3.00	.57667259E+03	6
13.69	6.32	32.20	-.97	-29.42	-6.61	1.00	.90105168E+03	7
16.37	13.69	46.54	32.25	-29.36	-20.90	2.00	.47906511E+03	8
13.69	11.67	32.34	23.26	-29.28	-6.61	1.00	.71090397E+03	9
18.56	9.79	54.32	14.86	-29.21	-28.52	1.00	.46919213E+03	10
9.79	3.58	14.86	-13.10	-29.20	0.00	1.00	.18861779E+04	11
12.97	9.79	29.18	14.90	-29.17	-3.35	6.00	.83680259E+03	12
9.79	8.18	15.32	8.06	-28.74	0.00	1.00	.14033389E+04	13
20.34	8.26	55.00	.65	-36.51	-36.51	1.00	.42460525E+03	14
14.18	8.50	27.28	1.74	-36.51	-8.79	1.00	.76807252E+03	15
16.60	8.98	38.26	4.00	-35.43	-19.69	1.00	.58153350E+03	16
13.77	10.79	25.61	12.18	-35.35	-6.98	7.00	.72996103E+03	17
14.74	3.42	30.61	-20.35	-35.72	-11.34	1.00	.92247814E+03	18
10.14	6.16	9.97	-7.94	-35.66	0.00	48.00	.14935730E+04	19
		10.11	-7.81			4.80		4.80000000
		10.37	-7.55			9.60		4.80000000
		10.63	-7.29			14.40		4.80000000
		10.89	-7.03			19.20		4.80000000
		11.14	-6.77			24.00		4.80000000
		11.40	-6.52			28.80		4.80000000
		11.65	-6.27			33.60		4.80000000
		11.90	-6.02			38.40		4.80000000
		12.15	-5.77			43.20		4.80000000
		12.40	-5.52			48.00		4.80000000
9.15	-.16	8.04	-33.84	-33.12	0.00	1.00	.30047963E+04	20
6.56	3.50	-3.56	-17.36	-33.09	0.00	35.00	.37392025E+04	21
		-3.52	-17.32			3.50		3.50000000
		-3.45	-17.25			7.00		3.50000000
		-3.38	-17.18			10.50		3.50000000
		-3.31	-17.11			14.00		3.50000000
		-3.24	-17.04			17.50		3.50000000
		-3.17	-16.97			21.00		3.50000000
		-3.10	-16.90			24.50		3.50000000
		-3.03	-16.83			28.00		3.50000000
		-2.96	-16.76			31.50		3.50000000
		-2.89	-16.69			35.00		3.50000000
19.45	2.10	55.00	-23.08	-32.52	-32.52	1.00	.58920931E+03	22
14.98	2.99	34.91	-19.08	-32.52	-12.42	9.00	.91708325E+03	23
10.14	5.03	13.57	-9.43	-32.07	0.00	10.00	.16047965E+04	24
20.09	14.18	55.00	28.37	-35.42	-35.42	1.00	.35855054E+03	25
-.78	-3.98	-38.93	-53.34	-35.42	0.00	1.00	.13025831E+05	26
22.76	14.98	55.00	25.02	-47.41	-47.41	1.00	.28748314E+03	27
23.67	13.69	55.00	10.09	-51.52	-51.52	1.00	.27916148E+03	28
14.18	8.90	12.27	-11.46	-51.52	-8.79	1.00	.75464468E+03	29
16.60	14.18	23.29	12.40	-51.39	-19.69	19.00	.48342514E+03	30
		23.44	12.54			1.90		1.90000000
		23.72	12.83			3.80		1.90000000
		24.00	13.11			5.70		1.90000000

		24.28	13.39			7.60		1.90000000
		24.56	13.66			9.50		1.90000000
		24.83	13.94			11.40		1.90000000
		25.11	14.21			13.30		1.90000000
		25.37	14.48			15.20		1.90000000
		25.64	14.75			17.10		1.90000000
		25.91	15.01			19.00		1.90000000
14.18	12.48	15.14	7.52	-48.65	-8.79	2.00	.65336542E+03	31
21.79	12.97	49.68	9.98	-48.37	-43.05	1.00	.32605652E+03	32
18.48	15.63	34.83	22.00	-48.33	-28.16	1.00	.39170979E+03	33
18.88	8.66	36.76	-9.24	-48.21	-29.98	1.00	.47468264E+03	34
12.08	10.63	6.23	-.31	-48.13	0.00	9.00	.90043347E+03	35
15.87	11.59	24.39	5.14	-47.03	-16.42	5.00	.56645141E+03	36
14.66	12.40	19.56	9.39	-46.41	-10.97	29.00	.62236611E+03	37
		19.75	9.58			2.90		2.90000000
		20.12	9.95			5.80		2.90000000
		20.50	10.33			8.70		2.90000000
		20.86	10.70			11.60		2.90000000
		21.23	11.06			14.50		2.90000000
		21.59	11.42			17.40		2.90000000
		21.94	11.78			20.30		2.90000000
		22.30	12.13			23.20		2.90000000
		22.65	12.48			26.10		2.90000000
		22.99	12.82			29.00		2.90000000
-.78	-3.98	-40.60	-55.70	-37.08	0.00	1.00	.13025831E+05	38
-1.05	-3.66	-41.80	-53.54	-37.08	0.00	1.00	.14337171E+05	39

THE NUMBER OF PEAKS OR VALLEYS IN THE INPUT LOAD SPECTRUM = 75

41

STEP	SIGMA MAXIMUM	SIGMA MINIMUM	COUNTER K
1	-.351045E+01	-.179154E+02	1.00000
2	.550000E+02	.428950E+02	1.00000
3	.428950E+02	.272795E+02	1.00000
4	.550000E+02	.495527E+02	1.00000
5	.550000E+02	.182008E+02	1.00000
6	.385372E+02	.294585E+02	3.00000
7	.321966E+02	-.971139E+00	1.00000
8	.465387E+02	.322548E+02	2.00000
9	.323357E+02	.232570E+02	1.00000
10	.543191E+02	.148568E+02	1.00000
11	.148601E+02	-.131024E+02	1.00000
12	.291797E+02	.148958E+02	6.00000
13	.153186E+02	.805562E+01	1.00000
14	.550000E+02	.648550E+00	1.00000
15	.272796E+02	.173800E+01	1.00000
16	.382570E+02	.399989E+01	1.00000
17	.256130E+02	.121764E+02	7.00000
18	.306127E+02	-.203494E+02	1.00000
19	.101054E+02	-.781000E+01	4.80000
20	.103674E+02	-.754800E+01	4.80000
21	.106275E+02	-.728793E+01	4.80000
22	.108856E+02	-.702978E+01	4.80000
23	.111419E+02	-.677353E+01	4.80000
24	.113962E+02	-.651917E+01	4.80000
25	.116487E+02	-.626669E+01	4.80000
26	.118993E+02	-.601607E+01	4.80000
27	.121481E+02	-.576729E+01	4.80000
28	.123950E+02	-.552036E+01	4.80000
29	.803921E+01	-.338441E+02	1.00000
30	-.352359E+01	-.173203E+02	3.50000
31	-.344941E+01	-.172491E+02	3.50000
32	-.337838E+01	-.171781E+02	3.50000
33	[illegible]	[illegible]	

34	-.323678E+01	-.170365E+02	3.50000
35	-.316621E+01	-.169659E+02	3.50000
36	-.309579E+01	-.168955E+02	3.50000
37	-.302552E+01	-.168252E+02	3.50000
38	-.295540E+01	-.167551E+02	3.50000
39	-.288544E+01	-.166851E+02	3.50000
40	.550000E+02	-.230772E+02	1.00000
41	.349357E+02	-.190826E+02	9.00000
42	.135658E+02	-.943374E+01	10.00000
43	.550000E+02	.283690E+02	1.00000
44	-.389348E+02	-.533397E+02	1.00000
45	.550000E+02	.200165E+02	1.00000
46	.550000E+02	.100905E+02	1.00000
47	.122694E+02	-.114564E+02	1.00000
48	.234369E+02	.125424E+02	1.90000
49	.237213E+02	.128268E+02	1.90000
50	.240031E+02	.131086E+02	1.90000
51	.242824E+02	.133879E+02	1.90000
52	.245592E+02	.136647E+02	1.90000
53	.248335E+02	.139390E+02	1.90000
54	.251053E+02	.142108E+02	1.90000
55	.253747E+02	.144802E+02	1.90000
56	.256416E+02	.147471E+02	1.90000
57	.259062E+02	.150117E+02	1.90000
58	.151434E+02	.751720E+01	2.00000
59	.496805E+02	.997609E+01	1.00000
60	.348288E+02	.219975E+02	1.00000
61	.367628E+02	-.923622E+01	1.00000
62	.622539E+01	-.311306E+00	9.00000
63	.243886E+02	.514165E+01	5.00000
64	.197465E+02	.957830E+01	2.90000
65	.201228E+02	.995459E+01	2.90000
66	.204951E+02	.103269E+02	2.90000
67	.208634E+02	.106952E+02	2.90000
68	.212277E+02	.110595E+02	2.90000
69	.215882E+02	.114200E+02	2.90000
70	.219448E+02	.117766E+02	2.90000
71	.222977E+02	.121295E+02	2.90000
72	.226467E+02	.124785E+02	2.90000
73	.229920E+02	.128238E+02	2.90000
74	-.405950E+02	-.550000E+02	1.00000
75	-.417990E+02	-.535408E+02	1.00000

RANGE PAIR CYCLE COUNTED SPECTRUM

STEP	SIGMA MAXIMUM	SIGMA MINIMUM	COUNTER K
1	-.351045E+01	-.179154E+02	1.00000
2	.550000E+02	.272795E+02	1.00000
3	.550000E+02	.495527E+02	1.00000
4	.550000E+02	-.550000E+02	1.00000
5	.321966E+02	.294585E+02	1.00000
6	.465387E+02	.322548E+02	1.00000
7	.465387E+02	.232570E+02	1.00000
8	.323357E+02	.322548E+02	1.00000
9	.543191E+02	-.971139E+00	1.00000
10	.148601E+02	.148568E+02	1.00000
11	.291797E+02	.148958E+02	5.00000
12	.291797E+02	.805562E+01	1.00000
13	.153186E+02	.148958E+02	1.00000
14	.550000E+02	-.131024E+02	1.00000
15	.272796E+02	.173800E+01	1.00000
16	.382570E+02	.648550E+00	1.00000
17	.306127E+02	.121764E+02	1.00000
18	.101054E+02	-.781000E+01	5.00000
19	.103674E+02	-.754800E+01	5.00000
20	.106275E+02	-.728793E+01	5.00000
21	.108856E+02	-.702978E+01	5.00000
22	.111419E+02	-.677353E+01	5.00000
23	.113962E+02	-.651917E+01	5.00000
24	.116487E+02	-.626669E+01	5.00000
25	.118993E+02	-.601607E+01	5.00000
26	.121481E+02	-.576729E+01	5.00000
27	.123950E+02	-.552036E+01	4.00000
28	.123950E+02	-.203494E+02	1.00000
29	.803921E+01	-.552036E+01	1.00000
30	-.352059E+01	-.173203E+02	4.00000
31	-.344941E+01	-.172491E+02	4.00000
32	-.337838E+01	-.171781E+02	4.00000
33	-.330750E+01	-.171072E+02	4.00000
34	-.323678E+01	-.170365E+02	4.00000
35	-.316621E+01	-.169659E+02	4.00000
36	-.309579E+01	-.168955E+02	4.00000
37	-.302552E+01	-.168252E+02	4.00000
38	-.295540E+01	-.167551E+02	4.00000
39	-.288544E+01	-.166851E+02	4.00000
40	.550000E+02	-.190826E+02	1.00000
41	.135658E+02	-.943374E+01	10.00000
42	.550000E+02	-.338441E+02	1.00000
43	.550000E+02	.200165E+02	1.00000
44	.550000E+02	-.533397E+02	1.00000
45	.234369E+02	.125424E+02	2.00000
46	.237213E+02	.128268E+02	2.00000
47	.240031E+02	.131086E+02	2.00000
48	.242824E+02	.133879E+02	2.00000
49	.245592E+02	.136647E+02	2.00000
50	.248335E+02	.139390E+02	2.00000
51	.251053E+02	.142108E+02	2.00000
52	.253747E+02	.144802E+02	2.00000
53	.256416E+02	.147471E+02	2.00000
54	.259062E+02	.150117E+02	1.00000
55	.259062E+02	.751720E+01	1.00000
56	.151434E+02	.150117E+02	1.00000
57	.151434E+02	.751720E+01	1.00000

58	.496835E+02	-.114564E+02	1.00000
59	[illegible]	.219975E+02	1.00000
[illegible]	[illegible]	.997609E+01	1.00000
61	.243885E+02	.514165E+01	4.00000
62	.243886E+02	-.311306E+00	1.00000
63	.197465E+02	.957830E+01	3.00000
64	.201228E+02	.995459E+01	3.00000
65	.204951E+02	.103269E+02	3.00000
66	.208634E+02	.106952E+02	3.00000
67	.212277E+02	.110595E+02	3.00000
68	.215882E+02	.114200E+02	3.00000
69	.219448E+02	.117766E+02	3.00000
70	.222977E+02	.121295E+02	3.00000
71	.226467E+02	.124785E+02	3.00000
72	.229920E+02	.128238E+02	2.00000
73	.229920E+02	.514165E+01	1.00000
74	-.417990E+02	-.535458E+02	1.00000

LOCAL STRESSES AND PLASTIC STRAINS W/RESULTING FATIGUE LIFE

STEP	PLASTIC STRAIN	MAX OR MIN	DAMAGE
2	.01696	MAX	.589085E-03
4	.00035	MAX	.236703E-05
5	.00022	MAX	.105771E-05
14	.00249	MAX	.891548E-04
22	.00004	MAX	.498022E-07
25	.00123	MAX	.242990E-04
27	.00423	MAX	.233133E-03
28	.00156	MAX	.379281E-04
38	.00063	MIN	.718916E-05

DAMAGE FROM PLASTIC STRAINS= .98426328E-03

SIGMAX	SIGMIN	RNCYC	CYCLES	ENN/CYC
-3.51	-17.92	1.	.10000000E+10	.10000000E-08
55.00	27.28	1.	.14807856E+06	.67531722E-05
55.00	49.55	1.	.69900694E+09	.14306010E-08
55.00	-55.00	1.	.10000000E+05	.10000000E-03
32.23	29.46	1.	.46901918E+12	.21321090E-11
46.54	32.25	1.	.11536870E+09	.86678619E-08
46.54	23.26	1.	.51785551E+07	.19310406E-06
32.34	32.25	1.	.36726287E+13	.27228454E-12
54.32	-.97	1.	.14931857E+05	.66970905E-04
14.86	14.86	1.	.50066416E+12	.19973469E-11
29.18	14.90	5.	.12665797E+10	.39476395E-08
29.18	8.06	1.	.14052164E+09	.71163418E-08
15.32	14.90	1.	.42187482E+12	.23703714E-11
55.00	-13.10	1.	.10000000E+05	.10000000E-03
27.28	1.74	1.	.53004668E+08	.18866263E-07
38.26	.65	1.	.17454008E+07	.57293429E-06
30.61	12.18	1.	.27966528E+09	.35757031E-08
10.11	-7.81	5.	.10000000E+10	.50000000E-08
10.37	-7.55	5.	.10000000E+10	.50000000E-08
10.63	-7.29	5.	.10000000E+10	.50000000E-08
10.89	-7.03	5.	.10000000E+10	.50000000E-08
11.14	-6.77	5.	.56054816E+09	.89198403E-08
11.40	-6.52	5.	.56088584E+09	.89144700E-08
11.65	-6.27	5.	.56115089E+09	.89102593E-08
11.90	-6.02	5.	.56134367E+09	.89071993E-08
12.15	-5.77	5.	.56146456E+09	.89052816E-08
12.40	-5.52	4.	.56151397E+09	.71235984E-08
12.40	-20.35	1.	.27376289E+08	.36527961E-07
8.04	-5.52	1.	.10000000E+10	.10000000E-08
-3.52	-17.32	4.	.10000000E+10	.40000000E-08
-3.45	-17.25	4.	.10000000E+10	.40000000E-08
-3.38	-17.18	4.	.10000000E+10	.40000000E-08

-3.31	-17.11	4.	.10000000E+10	.40000000E-08
-3.24	-17.04	4.	.10000000E+10	.40000000E-08
-3.17	-16.97	4.	.10000000E+10	.40000000E-08
-3.10	-16.90	4.	.10000000E+10	.40000000E-08
-3.03	-16.83	4.	.10000000E+10	.40000000E-08
-2.96	-16.76	4.	.10000000E+10	.40000000E-08
-2.89	-16.69	4.	.10000000E+10	.40000000E-08
55.00	-19.08	1.	.10000000E+05	.10000000E-03
13.57	-9.43	10.	.16603817E+09	.60227117E-07
55.00	-33.84	1.	.10000000E+05	.10000000E-03
55.00	20.02	1.	.63546690E+05	.15736461E-04
55.00	-53.34	1.	.10000000E+05	.10000000E-03
23.44	12.54	2.	.52786328E+10	.37888599E-09
23.72	12.83	2.	.52805280E+10	.37875000E-09
24.00	13.11	2.	.52807566E+10	.37873361E-09
24.28	13.39	2.	.52793259E+10	.37883625E-09
24.56	13.66	2.	.52762450E+10	.37905745E-09
24.83	13.94	2.	.52715248E+10	.37939687E-09
25.11	14.21	2.	.52651779E+10	.37985421E-09
25.37	14.48	2.	.52572184E+10	.38042931E-09
25.64	14.75	2.	.52476624E+10	.38112208E-09
25.91	15.01	1.	.52365271E+10	.19096626E-09
25.91	7.52	1.	.37589154E+09	.26603419E-08
15.14	15.01	1.	.48307951E+12	.20700526E-11
15.14	7.52	1.	.15515977E+11	.64449697E-10
49.68	-11.46	1.	.24152055E+05	.41404344E-04
34.83	22.00	1.	.15814258E+10	.63234078E-09
36.76	9.98	1.	.15038306E+08	.66496853E-07
24.39	5.14	4.	.31310615E+09	.12775220E-07
24.39	-.31	1.	.77428372E+08	.12915162E-07
19.75	9.58	3.	.67337984E+10	.44551379E-09
20.12	9.95	3.	.67798754E+10	.44248601E-09
20.50	10.33	3.	.68230691E+10	.43968484E-09
20.86	10.70	3.	.68633296E+10	.43710563E-09
21.23	11.06	3.	.69036119E+10	.43474405E-09
21.59	11.42	3.	.69348755E+10	.43259609E-09
21.94	11.78	3.	.69660846E+10	.43065799E-09
22.30	12.13	3.	.69942085E+10	.42892630E-09
22.65	12.48	3.	.70192214E+10	.42739783E-09
22.99	12.82	2.	.70411021E+10	.28404644E-09
22.99	5.14	1.	.49378912E+09	.20251560E-08
-41.80	-53.54	1.	.10000000E+10	.10000000E-08

DAMAGE PER THIS SET= .16162546E-02

TOTAL ENN/CYC =, .16162546E-02

FLIGHT OR BLOCK NO. 2

STMAX	STMIN	SIGMAX	SIGMIN	RES	EQRES	ENN	NEP	
-.78	-3.98	-40.58	-54.99	-37.07	0.00	1.00	.13025831E+05	1
18.40	15.71	45.73	33.63	-37.07	-27.83	1.00	.39342782E+03	2
15.71	12.24	33.68	18.07	-37.01	-15.69	1.00	.56235689E+03	3
18.64	17.43	46.96	41.52	-36.92	-28.89	1.00	.36717948E+03	4
18.80	10.63	47.74	10.94	-36.87	-29.61	1.00	.44621680E+03	5
15.14	13.13	31.31	22.24	-35.84	-13.15	3.00	.57667259E+03	6
13.69	6.32	25.06	-8.11	-36.55	-6.61	1.00	.90105168E+03	7
16.87	13.69	39.42	25.14	-36.48	-20.90	2.00	.47906511E+03	8
13.69	11.67	25.29	16.21	-36.33	-6.61	1.00	.71090397E+03	9
18.56	9.79	47.29	7.83	-36.23	-28.52	1.00	.46919213E+03	10
9.79	3.58	7.87	-20.13	-36.20	0.00	1.00	.18861779E+04	11
12.97	9.79	22.20	7.91	-35.15	-3.35	6.00	.83680259E+03	12
9.79	8.18	8.45	1.19	-35.61	0.00	1.00	.14033389E+04	13
20.34	8.26	55.00	.65	-36.51	-36.51	1.00	.42460525E+03	14
14.18	8.50	27.28	1.74	-36.51	-8.79	1.00	.76807252E+03	15
16.60	8.98	38.26	4.03	-36.43	-19.69	1.00	.58153350E+03	16
13.77	10.79	25.61	12.18	-36.35	-6.98	7.00	.72996103E+03	17
14.74	3.42	30.61	-20.35	-35.72	-11.34	1.00	.92247814E+03	18

10.14	0.16	9.97	-7.94	-35.65	[illegible]	48.00	.14935730E+04	19
		[illegible]	-7.81			4.80		4.80000000
		[illegible]	[illegible]			9.60		4.80000000
		[illegible]	-7.29			14.40		4.80000000
		[illegible]	-7.03			19.20		4.80000000
		[illegible]	-6.77			24.00		4.80000000
		11.40	-6.52			28.80		4.80000000
		11.65	-6.27			33.60		4.80000000
		11.90	-6.02			38.40		4.80000000
		12.15	-5.77			43.20		4.80000000
		12.40	-5.52			48.00		4.80000000
9.15	-.16	8.04	-33.84	-33.12	0.00	1.00	.30047963E+04	20
6.56	3.50	-3.56	-17.36	-33.09	0.00	35.00	.37392025E+04	21
		-3.52	-17.32			3.50		3.50000000
		-3.45	-17.25			7.00		3.50000000
		-3.38	-17.18			10.50		3.50000000
		-3.31	-17.11			14.00		3.50000000
		-3.24	-17.04			17.50		3.50000000
		-3.17	-16.97			21.00		3.50000000
		-3.10	-16.90			24.50		3.50000000
		-3.03	-16.83			28.00		3.50000000
		-2.96	-16.76			31.50		3.50000000
		-2.89	-16.69			35.00		3.50000000
19.45	2.10	55.00	-23.08	-32.52	-32.52	1.00	.58923931E+03	22
14.98	2.99	34.91	-19.08	-32.52	-12.42	9.00	.91708325E+03	23
10.14	5.03	13.57	-9.43	-32.17	0.00	10.00	.16047965E+04	24
20.09	14.18	55.00	28.37	-35.42	-35.42	1.00	.35855054E+03	25
-.78	-3.98	-38.93	-53.34	-35.42	0.00	1.00	.13025831E+05	26
22.76	14.98	55.00	20.87	-47.41	-47.41	1.00	.28748314E+03	27
23.67	13.69	55.00	10.09	-51.52	-51.52	1.00	.27916148E+03	28
14.18	8.90	12.27	-11.46	-51.52	-8.79	1.00	.75464468E+03	29
16.60	14.18	23.29	12.40	-51.39	-19.69	19.00	.48342514E+03	30
		23.44	12.54			1.90		1.90000000
		23.72	12.83			3.80		1.90000000
		24.00	13.11			5.70		1.90000000
		24.28	13.39			7.60		1.90000000
		24.56	13.66			9.50		1.90000000
		24.83	13.94			11.40		1.90000000
		25.11	14.21			13.30		1.90000000
		25.37	14.48			15.20		1.90000000
		25.64	14.75			17.10		1.90000000
		25.91	15.01			19.00		1.90000000
14.18	12.48	15.14	7.52	-48.65	-8.79	2.00	.65336542E+03	31
21.79	12.97	49.68	9.98	-48.37	-43.05	1.00	.32605652E+03	32
18.48	15.63	34.83	22.00	-48.33	-28.15	1.00	.39170979E+03	33
18.88	8.66	36.76	-9.24	-48.21	-29.98	1.00	.47468264E+03	34
12.08	10.63	6.23	-.31	-48.13	0.00	9.00	.90043347E+03	35
15.87	11.59	24.39	5.14	-47.03	-16.42	5.00	.56645141E+03	36
14.66	12.40	19.56	9.39	-46.41	-10.97	29.00	.62236611E+03	37
		19.75	9.58			2.90		2.90000000
		20.12	9.95			5.80		2.90000000
		20.50	10.33			8.70		2.90000000
		20.86	10.70			11.60		2.90000000
		21.23	11.06			14.50		2.90000000
		21.59	11.42			17.40		2.90000000
		21.94	11.78			20.30		2.90000000
		22.30	12.13			23.20		2.90000000
		22.65	12.48			26.10		2.90000000
		22.99	12.82			29.00		2.90000000
-.78	-3.98	-40.60	-55.00	-37.08	0.00	1.00	.13025831E+05	38
-1.05	-3.66	-41.80	-53.54	-37.08	0.00	1.00	.14337171E+05	39

LOCAL STRESSES AND FLASTIC STRAINS W/RESULTING FATIGUE LIFE

STEP * FLASTIC STRAIN MAX OR MIN DAMAGE

14	.00032	MAX	.202856E-05
22	.00004	MAX	.498022E-07
25	.00123	MAX	.242990E-04
27	.00420	MAX	.233133E-03
28	.00156	MAX	.379281E-04
38	.00063	MIN	.718916E-05

DAMAGE FROM PLASTIC STRAINS= .30462764E-03

SIGMAX	SIGMIN	RNCYC	CYCLES	ENN/CYC
-40.58	-54.99	1.	.10000000E+10	.10000000E-08
45.73	18.07	1.	.24093777E+07	.41504493E-06
33.68	33.63	1.	.43206072E+13	.23144895E-12
46.96	41.52	1.	.23661145E+11	.42263381E-10
47.74	-20.10	1.	.19780666E+05	.50554416E-04
25.06	22.24	1.	.27937764E+12	.35793846E-11
39.42	25.14	1.	.50516846E+09	.19795377E-08
39.42	16.21	1.	.24432813E+08	.40928567E-07
25.29	25.14	1.	.15753982E+13	.63476016E-12
47.29	-8.11	1.	.58801786E+05	.17006286E-04
7.87	7.83	1.	.10000000E+10	.10000000E-08
22.20	7.91	5.	.15461310E+10	.32338787E-08
22.20	1.19	1.	.21206560E+09	.47155219E-08
8.45	7.91	1.	.10000000E+10	.10000000E-08
55.00	-53.34	1.	.10000000E+05	.10000000E-03
27.28	1.74	1.	.53004668E+08	.18866263E-07
38.26	.65	1.	.17454008E+07	.57293429E-06
30.61	12.18	1.	.27966528E+09	.35757031E-08
10.11	-7.81	5.	.10000000E+10	.50000000E-08
10.37	-7.55	5.	.10000000E+10	.50000000E-08
10.63	-7.29	5.	.10000000E+10	.50000000E-08
10.89	-7.03	5.	.10000000E+10	.50000000E-08
11.14	-6.77	5.	.56054816E+09	.89198403E-08
11.40	-6.52	5.	.56088584E+09	.89144700E-08
11.65	-6.27	5.	.56115089E+09	.89102593E-08
11.90	-6.02	5.	.56134367E+09	.89071993E-08
12.15	-5.77	5.	.56146456E+09	.89052816E-08
12.40	-5.52	4.	.56151397E+09	.71235984E-08
12.40	-20.35	1.	.27376289E+08	.36527961E-07
8.04	-5.52	1.	.10000000E+10	.10000000E-08
-3.52	-17.32	4.	.10000000E+10	.40000000E-08
-3.45	-17.25	4.	.10000000E+10	.40000000E-08
-3.38	-17.18	4.	.10000000E+10	.40000000E-08
-3.31	-17.11	4.	.10000000E+10	.40000000E-08
-3.24	-17.04	4.	.10000000E+10	.40000000E-08
-3.17	-16.97	4.	.10000000E+10	.40000000E-08
-3.10	-16.90	4.	.10000000E+10	.40000000E-08
-3.03	-16.83	4.	.10000000E+10	.40000000E-08
-2.96	-16.76	4.	.10000000E+10	.40000000E-08
-2.89	-16.69	4.	.10000000E+10	.40000000E-08
55.00	-19.88	1.	.10000000E+05	.10000000E-03
13.57	-9.43	10.	.16603817E+09	.60227117E-07
55.00	-33.84	1.	.10000000E+05	.10000000E-03
55.00	20.02	1.	.63546690E+05	.15736461E-04
55.00	-55.00	1.	.10000000E+05	.10000000E-03
23.44	12.54	2.	.52786328E+10	.37888599E-09
23.72	12.83	2.	.52805280E+10	.37875000E-09
24.00	13.11	2.	.52807566E+10	.37873361E-09
24.28	13.39	2.	.52793259E+10	.37883625E-09
24.56	13.66	2.	.52762450E+10	.37905745E-09
24.83	13.94	2.	.52715248E+10	.37939687E-09
25.11	14.21	2.	.52651779E+10	.37985421E-09
25.37	14.48	2.	.52572184E+10	.38042931E-09
25.64	14.75	2.	.52476624E+10	.38112208E-09
25.91	15.01	1.	.52365271E+10	.19096626E-09
25.91	7.32	1.	.37589154E+09	.26603419E-08
15.14	15.01	1.	.48307951E+12	.20700526E-11

15.14	7.52	1.	.15515977E+11	.64449697E-10
[illegible]	-11.46	1.	.24152055E+05	.41404344E-04
[illegible]	[illegible]	1.	.15814258E+10	.63234078E-09
[illegible]	[illegible]	1.	.15038306E+08	.66496853E-07
[illegible]	[illegible]	4.	.31310615E+09	.12775220E-07
[illegible]	-.31	1.	.77428372E+08	.12915162E-07
19.75	9.58	3.	.67337984E+10	.44551379E-09
20.12	9.95	3.	.67798754E+10	.44248601E-09
20.50	10.33	3.	.68230691E+10	.43968484E-09
20.86	10.70	3.	.68633296E+10	.43710563E-09
21.23	11.06	3.	.69006119E+10	.43474465E-09
21.59	11.42	3.	.69348755E+10	.43259609E-09
21.94	11.78	3.	.69660846E+10	.43065799E-09
22.30	12.13	3.	.69942085E+10	.42892630E-09
22.65	12.48	3.	.70192214E+10	.42739783E-09
22.99	12.82	2.	.70411021E+10	.28404644E-09
22.99	5.14	1.	.49378912E+09	.20251560E-08
-41.80	-53.54	1.	.10000000E+10	.10000000E-08

DAMAGE PER THIS SET= .83070929E-03

TOTAL ENN/CYC =, .24469639E-02

FLIGHT OR BLOCK NO. 3

STMAX	STMIN	SIGMAX	SIGMIN	RES	EQRES	ENN	NEP	
-.78	-3.98	-40.58	-54.93	-37.07	0.00	1.00	.13025831E+05	1
24.08	15.71	55.08	17.35	-53.34	-53.34	1.00	.25777999E+03	2
18.40	15.71	29.46	17.35	-53.34	-27.81	1.00	.39342782E+03	3
15.71	12.24	17.50	1.89	-53.19	-15.69	1.00	.56235689E+03	4
18.64	17.43	30.85	20.40	-53.04	-28.39	1.00	.36717948E+03	5
10.8[illegible]	10.63	31.73	-5.07	-52.89	-29.61	1.00	.44621680E+03	6
15.14	13.13	15.38	6.31	-52.77	-13.15	3.00	.57667259E+03	7
13.69	6.32	9.32	-23.85	-52.29	-6.61	1.00	.90105168E+03	8
16.07	13.69	23.72	9.44	-52.18	-20.97	2.00	.47906511E+03	9
13.69	11.67	9.74	.66	-51.88	-6.61	1.00	.71090397E+03	10
18.56	9.79	31.79	-7.67	-51.73	-28.52	1.00	.46919213E+03	11
9.79	3.58	-7.56	-35.52	-51.62	0.00	1.00	.18861779E+04	12
12.97	9.79	6.79	-7.49	-51.56	-3.35	6.00	.83680259E+03	13
9.79	8.18	-6.70	-13.97	-50.77	0.00	1.00	.14033389E+04	14
20.34	8.26	40.83	-13.52	-50.68	-36.51	1.00	.42460525E+03	15
14.18	8.50	13.19	-12.35	-50.61	-8.79	1.00	.76807252E+03	16
19.05	14.66	35.22	15.49	-50.48	-30.71	1.00	.38464145E+03	17
16.60	8.98	24.32	-9.93	-50.35	-19.69	1.00	.58153350E+03	18
13.77	10.79	11.74	-1.70	-50.24	-6.98	7.00	.72996103E+03	19
14.74	3.42	17.04	-33.92	-49.30	-11.34	1.00	.92247814E+03	20
10.14	6.16	-3.57	-21.48	-49.20	0.00	48.00	.14935730E+04	21
		-3.39	-21.30			4.80		4.80000000
		-3.02	-20.94			9.60		4.80000000
		-2.66	-20.58			14.40		4.80000000
		-2.31	-20.22			19.20		4.80000000
		-1.96	-19.87			24.00		4.80000000
		-1.60	-19.52			28.80		4.80000000
		-1.26	-19.17			33.60		4.80000000
		-.91	-18.83			38.40		4.80000000
		-.57	-18.48			43.20		4.80000000
		-.23	-18.14			48.00		4.80000000
9.15	-.16	-4.54	-46.42	-45.69	0.00	1.00	.30047963E+04	22
6.56	3.50	-16.12	-29.92	-45.65	0.00	35.00	.37392025E+04	23
		-16.07	-29.87			3.50		3.50000000
		-15.97	-29.77			7.00		3.50000000
		-15.88	-29.68			10.50		3.50000000
		-15.78	-29.58			14.00		3.50000000
		-15.68	-29.48			17.50		3.50000000
		-15.58	-29.38			21.00		3.50000000
		-15.49	-29.29			24.50		3.50000000
		-15.39	-29.19			28.00		3.50000000
		-15.29	-29.09			31.50		3.50000000

		-15.20	-29.00			35.30		3.50000000
19.45	2.10	42.84	-35.24	-44.68	-32.52	1.00	.58920931E+03	24
14.98	2.99	22.79	-31.20	-44.64	-12.42	9.00	.91708325E+03	25
10.14	5.03	1.72	-21.28	-43.92	0.00	10.00	.16047965E+04	26
23.75	-3.23	60.71	-60.71	-46.18	-51.89	1.00	.50647169E+03	27
20.09	14.18	44.22	17.59	-46.21	-35.42	1.00	.35855054E+03	28
-.78	-3.98	-40.60	-55.00	-37.08	0.00	1.00	.13025831E+05	29
22.76	14.98	55.00	20.02	-47.41	-47.41	1.00	.28748314E+03	30
23.67	13.69	55.00	10.09	-51.52	-51.52	1.00	.27916148E+03	31
14.18	8.90	12.27	-11.46	-51.52	-8.79	1.00	.75464468E+03	32
16.60	14.18	23.29	12.40	-51.39	-19.69	19.00	.48342514E+03	33
		23.44	12.54			1.90		1.90000000
		23.72	12.83			3.80		1.90000000
		24.00	13.11			5.70		1.90000000
		24.28	13.39			7.60		1.90000000
		24.56	13.66			9.50		1.90000000
		24.83	13.94			11.40		1.90000000
		25.11	14.21			13.30		1.90000000
		25.37	14.48			15.20		1.90000000
		25.64	14.75			17.10		1.90000000
		25.91	15.01			19.00		1.90000000
14.18	12.48	15.14	7.52	-48.65	-8.79	2.00	.65336542E+03	34
21.79	12.97	49.68	9.98	-48.37	-43.05	1.00	.32605652E+03	35
18.48	15.63	34.83	22.00	-48.33	-28.15	1.00	.39173979E+03	36
18.88	8.66	36.76	-9.24	-48.21	-29.98	1.00	.47468264E+03	37
12.08	10.63	6.23	-.31	-48.13	0.00	9.00	.90043347E+03	38
15.87	11.59	24.39	5.14	-47.03	-16.42	5.00	.56645141E+03	39
14.66	12.40	19.56	9.39	-46.41	-10.97	29.00	.62236611E+03	40
		19.75	9.58			2.90		2.90000000
		20.12	9.95			5.80		2.90000000
		20.50	10.33			8.70		2.90000000
		20.86	10.70			11.60		2.90000000
		21.23	11.06			14.50		2.90000000
		21.59	11.42			17.40		2.90000000
		21.94	11.78			20.30		2.90000000
		22.30	12.13			23.20		2.90000000
		22.65	12.48			26.10		2.90000000
		22.99	12.82			29.00		2.90000000
-.78	-3.98	-40.60	-55.00	-37.08	0.00	1.00	.13025831E+05	41
-1.05	-3.66	-41.80	-53.54	-37.08	0.00	1.00	.14337171E+05	42

LOCAL STRESSES AND PLASTIC STRAINS W/RESULTING FATIGUE LIFE

STEP	PLASTIC STRAIN	MAX OR MIN	DAMAGE
2	.00593	MAX	.438461E-03
27	.00321	MAX	.141845E-03
29	.00185	MIN	.183981E-04
30	.00365	MAX	.180144E-03
31	.00156	MAX	.379281E-04
41	.00063	MIN	.718916E-05

DAMAGE FROM PLASTIC STRAINS= .82396546E-03

SIGMAX	SIGMIN	RNCYC	CYCLES	ENN/CYC
-40.58	-54.99	1.	.10000000E+10	.10000000E-08
55.00	-46.42	1.	.10000000E+05	.10000000E-03
29.46	17.35	1.	.29397878E+10	.34016060E-09
17.50	17.35	1.	.63000870E+12	.15872797E-11
30.85	25.43	1.	.77590688E+11	.12888145E-10
31.73	1.89	1.	.14305010E+08	.69905579E-07
9.32	6.31	1.	.10000000E+10	.10000000E-08
23.72	9.44	1.	.15092544E+10	.66257884E-09
23.72	.66	1.	.11830863E+09	.84524691E-08
9.74	9.44	1.	.10000000E+10	.10000000E-08
31.79	-23.85	1.	.46704942E+06	.21411011E-05
-7.56	-7.67	1.	[illegible]	[illegible]

67

6.79	-7.49	5.	.10000000E+10	.50000000E-08
6.79	-13.97	1.	.10000000E+10	.10000000E-08
6.79	-7.49	1.	.10000000E+10	.10000000E-08
[illegible]	[illegible]	1.	.26034162E+05	.38455383E-04
[illegible]	12.35	1.	.97971982E+08	.10207000E-07
[illegible]	-16.52	1.	.65291215E+06	.15315996E-05
[illegible]	-1.70	7.	.19249496E+10	.36364588E-08
17.04	-9.93	1.	.66014698E+08	.15148142E-07
-3.02	-20.94	5.	.10000000E+10	.50000000E-08
-2.66	-20.58	5.	.10000000E+10	.50000000E-08
-2.31	-20.22	5.	.10000000E+10	.50000000E-08
-1.96	-19.87	5.	.10000000E+10	.50000000E-08
-1.60	-19.52	5.	.10000000E+10	.50000000E-08
-1.26	-19.17	5.	.10000000E+10	.50000000E-08
-.91	-18.83	5.	.10000000E+10	.50000000E-08
-.57	-18.48	5.	.10000000E+10	.50000000E-08
-.23	-18.14	4.	.10000000E+10	.40000000E-08
-.23	-21.30	1.	.10000000E+10	.10000000E-08
-4.54	-18.14	1.	.10000000E+10	.10000000E-08
-16.07	-29.87	4.	.10000000E+10	.40000000E-08
-15.97	-29.77	4.	.10000000E+10	.40000000E-08
-15.88	-29.68	4.	.10000000E+10	.40000000E-08
-15.78	-29.58	4.	.10000000E+10	.40000000E-08
-15.68	-29.48	4.	.10000000E+10	.40000000E-08
-15.58	-29.38	4.	.10000000E+10	.40000000E-08
-15.49	-29.29	4.	.10000000E+10	.40000000E-08
-15.39	-29.19	4.	.10000000E+10	.40000000E-08
-15.29	-29.09	4.	.10000000E+10	.40000000E-08
-15.20	-29.00	4.	.10000000E+10	.40000000E-08
42.84	-31.20	1.	.24386594E+05	.41006136E-04
1.72	-21.28	10.	.10000000E+10	.10000000E-07
60.71	-55.00	1.	.10000000E+05	.10000000E-03
55.00	20.02	1.	.63546690E+05	.15736461E-04
55.00	-55.00	1.	.10000000E+05	.10000000E-03
23.44	12.54	2.	.52786328E+10	.37888599E-09
23.72	12.83	2.	.52805280E+10	.37875000E-09
24.00	13.11	2.	.52807566E+10	.37873361E-09
24.28	13.39	2.	.52793259E+10	.37883625E-09
24.56	13.66	2.	.52762450E+10	.37905745E-09
24.83	13.94	2.	.52715248E+10	.37939687E-09
25.11	14.21	2.	.52651779E+10	.37985421E-09
25.37	14.48	2.	.52572184E+10	.38042931E-09
25.64	14.75	2.	.52476624E+10	.38112208E-09
25.91	15.01	1.	.52365271E+10	.19096626E-09
25.91	7.52	1.	.37589154E+09	.26603419E-08
15.14	15.01	1.	.48307951E+12	.20700526E-11
15.14	7.52	1.	.15515977E+11	.64449697E-10
49.68	-11.46	1.	.24152055E+05	.41404344E-04
34.83	22.00	1.	.15814258E+10	.63234078E-09
36.76	9.98	1.	.15038306E+08	.66496853E-07
24.39	5.14	4.	.31310615E+09	.12775220E-07
24.39	-.31	1.	.77428372E+08	.12915162E-07
19.75	9.58	3.	.67337984E+10	.44551379E-09
20.12	9.95	3.	.67798754E+10	.44248601E-09
20.50	10.33	3.	.68230691E+10	.43968484E-09
20.86	10.70	3.	.68633296E+10	.43710563E-09
21.23	11.06	3.	.69006119E+10	.43474405E-09
21.59	11.42	3.	.69348755E+10	.43259609E-09
21.94	11.78	3.	.69660846E+10	.43065799E-09
22.30	12.13	3.	.69942085E+10	.42892630E-09
22.65	12.48	3.	.70192214E+10	.42739783E-09
22.99	12.82	2.	.70411021E+10	.28404644E-09
22.99	5.14	1.	.49378912E+09	.20251500E-08
-41.80	-53.54	1.	.10000000E+10	.10000000E-08

DAMAGE PER THIS SET= .12645622E-02

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FLIGHT OR BLOCK NO.    4       TOTAL ENN/CYC =,  .37115261E-02
                               DAMAGE FROM PLASTIC STRAINS=  .30462764E-03
                               DAMAGE PER THIS SET=  .83070929E-03
FLIGHT OR BLOCK NO.    5       TOTAL ENN/CYC =,  .45422354E-02
                               DAMAGE FROM PLASTIC STRAINS=  .22665690E-02
                               DAMAGE PER THIS SET=  .26509046E-02
FLIGHT OR BLOCK NO.    6       TOTAL ENN/CYC =,  .71931400E-02
                               DAMAGE FROM PLASTIC STRAINS=  .30462764E-03
                               DAMAGE PER THIS SET=  .83070929E-03
FLIGHT OR BLOCK NO.    7       TOTAL ENN/CYC =,  .80238493E-02
                               DAMAGE FROM PLASTIC STRAINS=  .30462764E-03
                               DAMAGE PER THIS SET=  .83070929E-03
                               TOTAL ENN/CYC =,  .88545586E-02
```

51

MEDIA CONVERSION LISTING LABEL/ CARDS

INPUT FILE 1 2 3 4 5 6 7 8 9
RECORD NUMBER 1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890

									000001
	1 1		1						000002
	8-1 SPECTRUM	--	TRUNCATION LEVEL		270,000 CYCLES				000003
	2219-T851 AL		55.		.40	-1.836	10000.		000004
	-.00217		.22041		55.82462	NORTH AMERICAN	4	2219	000005
	-.00176		.33210		48.26657	NORTH AMERICAN	5	2219	000006
	-.00149		.46283		39.66455	NORTH AMERICAN	6	2219	000007
	-.00243		.64199		31.70955	NORTH AMERICAN	7	2219	000008
	2200000.		1.		1.				000009
4.5	2.67								000010
		7.	44	3					000011
26.9	23.3								000012
	1	1	-.148		-.029	1.			000013
	2	3	.584		1.	1.			000014
	3	2	.584		.895	1.			000015
	4	1	.584		.684	1.			000016
	5	1	.455		.584	1.			000017
	6	1	.648		.693	1.			000018
	7	1	.395		.699	1.			000019
	8	1	.488		.563	3.			000020
	9	1	.235		.509	1.			000021
	10	1	.509		.627	2.			000022
	11	1	.434		.509	1.			000023
	12	1	.364		.69	1.			000024
	13	1	.133		.364	1.			000025
	14	1	.364		.482	6.			000026
	15	1	.304		.364	1.			000027
	16	1	.307		.756	1.			000028
	17	1	.316		.527	1.			000029
	18	2	.545		.708	1.			000030
	19	1	.334		.617	1.			000031
	20	1	.401		.512	7.			000032
	21	1	.127		.548	1.			000033
	22	1	.229		.377	48.			000034
	23	1	-.006		.340	1.			000035
	24	1	.13		.244	35.			000036
	25	1	.078		.723	1.			000037
	26	1	.111		.557	9.			000038
	27	1	.187		.377	10.			000039
	28	3	.527		.991	1.			000040
	29	2	-.12		.883	1.			000041
	30	1	.527		.747	1.			000042
	31	1	-.148		-.029	1.			000043
	32	1	.557		.846	1.			000044
	33	1	.509		.880	1.			000045
	34	1	.331		.527	1.			000046
	35	1	.527		.617	19.			000047
	36	1	.464		.527	2.			

INPUT FILE 0 1 2 3 4 5 6 7 8 9 OUTPUT FILE
RECORD NUMBER 1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890 RECORD NUMBER

PAGE 1

PCN NI02001

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PREPARED: 73 SEP 17                          MEDIA CONVERSION LISTING            LABEL/ CARDS                 PCN N102001

 INPUT FILE    0         1         2         3         4         5         6         7         8         9          OUTPUT FILE
RECORD NUMBER  1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890  RECORD NUMBER

                      37 1         .482                .81                 1.                                          000048
                      38 1         .581                .687                1.                                          000049
                      39 1         .322                .702                1.                                          000050
                      40 1         .395                .449                9.                                          000051
                      41 1         .431                .59                 5.                                          000052
                      42 1         .461                .545                29.                                         000053
                      43 1         -.148               -.029               1.                                          000054
                      44 1         -.136               -.039               1.                                          000055
                       1 1                                                                                             000056
                       2 1                                                                                             000057
                       3 2    1                                                                                        000058
                       4 1                                                                                             000059
                       5 3    1                                                                                        000060
                       6 1                                                                                             000061
                       7 1                                                                                             000062
```

53

APPENDIX III

LIST OF COMPUTER PROGRAM SYMBOLS AND DEFINITIONS

A	Coefficient of the x^2 term in the equation of a line on a constant life fatigue diagram where minimum stress is x and maximum stress is y. $(R = Ax^2 + Bx + C - y)$
AA	An assigned value of +1. or -1.
AAA	A stress used in the calculation of plastic strain.
ABDIF	The absolute value of DIF.
ABM	The absolute value of ASMAX or of ASMIN, as assigned.
ABMAX	The absolute value of ASMAX.
ABMEAN	The absolute value of ASMEAN.
ABMIN	The absolute value of ASMIN.
ABR4	The absolute value of R(4).
ABR7	The absolute value of R(7).
ABS	The name of a routine calling for the absolute value of a quantity.
AKT	Stress concentration factor, K_t
ASE	Array of values of ENN, for the plotting subroutine.
ASMAX	The product (AKT) (STMAX)
ASMEAN	The quantity (ASMAX + ASMIN)/2
ASMIN	The product (AKT)(STMIN)
ASN	Array of values of ASMIN, for the plotting subroutine.
ASX	Array of values of ASMAX, for the plotting subroutine.
AVSGMN	Average value of SIGMIN over an interval.
AVSGMX	Average value of SIGMAX over an interval.

B	Coefficient of the x term. (See A.)
BBB	A stress used in the calculation of plastic strain.
C	The constant. (See A.)
COFMAN	Inverse of the Coffin-Manson slope.
CYCINT	The number of cycles in an interval.
CYCLES	The calculated number of cycles expected to be indicated on a constant life fatigue diagram for the applied combination of maximum and minimum stress.
C1	The Residual Stress Relaxation Constant (See ENEP.)
DAM	Damage.
DECK	Decimal or real value of integer K after conversion.
DEL2	A portion of a least-squares-method solution.
DIF	The difference between residual stress and equilibrium residual stress. (RES(I) - EQRES)
DO2	A portion of a least-squares-method solution.
DUMMY	A variable used in the calculation of the number of cycles to be considered as an interval for relaxation determination.
ELMOD	The elastic modulus.
EN	The number of cycles from the beginning of the relaxation process to the end of the current interval.
ENEP	The number of cycles required for overload residual stress effect to return to within one-tenth of its original difference from equilibrium conditions. ($N_{ep} = C1/(ABM)^{E1}(ABMEAN)^{E2}$)

ENN — The number of applied cycles at a load level.

ENNCYC — The ratio of the number of applied cycles to the number of cycles to failure. (ENN/CYCLES)

EPSD — LCF strain intercept.

EQRES — Equilibrium residual stress.

EX — An exponential function depicting the relaxation of residual stress.

EXP — The name of a routine calling for the exponential value of a quantity.

EXPO — An exponent. The power of 10 which indicates the number of cycles to failure.

E1, E2 — Residual stress Relaxation Exponents.

FLOAT — The name of a routine calling for integer-to-real conversion.

I — A variable subscript.

IBLOCK — The identifying number of a block the blocks being numbered consecutively from 1 to NBLOCK.

IFIX — The name of a routine calling for real-to-integer conversion.

IN — The number of steps input to the range pair counting subroutine.

IPRINT — Value controlling the WRITE statements.

IRAIN — A counter.

IRPCM — Value controlling entry into the range pair counting subroutine.

ISTEP	The identifying step number, the steps being numbered from 1 to NLEVEL.
ITYPE	The identifying type number, the types being numbered from 1 to NTYPE.
J	A variable subscript.
JA	Value of +1 or 0, as assigned for branch determination.
JB	Value of -1 or 0, as assigned for branch determination.
JJ	An index variable.
JJJ	An index variable.
JKL	An index variable.
K	An index variable.
KK	An index variable.
KPMAX	The number of steps output from the range pair counting subroutine.
L	An index variable.
LMN	An index variable.
M	An index variable.
N	An index variable with values of N=4-7 indicating the power of 10, and thus identifying a particular life cycle curve.
NBLOCK	The total number of times to execute a block of loads.
NDECK	The number of data decks to be run sequentially.
NFLAG	An integer used as a counter.
NFLAG2	An integer used as a counter.

NLEVEL — The total number of steps, or levels, of loads in a block.

NN — A subscripted variable used to indicate which types of loads are experienced in which blocks.

NTYPE — The total number of different types.

PLSTRA — Plastic strain.

R — Residue term in damage calculation.

RES — Residual stress.

RNCYC — The number of cycles for a level after exitting the range pair counting subroutine.

SIGMAX — Maximum stress.

SIGMIN — Minimum stress.

STMAX — Maximum applied stress.

STMIN — Minimum applied stress.

SUMDEL — Summation of damage for a flight.

SUMENN — Accumulated total of applied cycles. (Summation of ENN).

SUMNC — Accumulated cycle ratio. (Summation of ENN/CYCLES).

SUMR — Summation of R(N), N=4,7.

SUMRN — Summation of nR(N), N=4,7. n=4.

SUMR2 — Summation of $R(N)^2$, N=4,7.

SUMR2N — Summation of $nR(N)^2$, N=4,7. n=4.

SUMR3 — Summation of $R(N)^3$, N=4,7.

SUMR4 — Summation of $R(N)^4$, N=4,7.

TITLE1,TITLE2 — Identification of the source of the SN data.

TLL — Tensile load limit.

TM1,TM2 — Material type.

TTYS	One-fifth of tensile yield stress.
TYS	Tensile yield stress.
T1,T2,T3,T4,T5,T6,T7,T8	Test identifying information.
X	Variable equivalent to SIGMIN.
Y	Variable equivalent to SIGMAX.

APPENDIX IV

FATIGUE LIFE INPUT DATA FLR SEVERAL MATERIALS

MATERIAL	YIELD STRESS	STRAIN INTERCEPT	INVERSE OF SLOPE	LIFE, 10^I	S-N LIFE COEFFICIENTS A(I)	B(I)	C(I)
2024-T4	58.	0.4	-1.836	4	-.0020	.2091	62.6
				5	-.0032	.4366	51.4
				6	-.0035	.6207	42.2
				7	-.0042	.7003	36.1
2219-T851	55.	0.4	-1.836	4	-.0022	.2204	55.8
				5	-.0018	.3320	48.3
				6	-.0015	.4628	39.7
				7	-.0024	.6420	31.7
7075-T6	72.	0.4	-1.836	4	-.0020	.2801	71.7
				5	-.0022	.5154	56.3
				6	-.0014	.6141	44.6
				7	-.0013	.6838	38.1
RQC-100	125.	0.54	-1.493	4	0.0	.2136	98.3
				5	0.0	.2927	88.5
				6	0.0	.3669	79.1
				7	0.0	.4376	70.3
Man-Ten	55.	1.11	-1.667	4	0.0	.2257	63.5
				5	0.0	.3520	53.1
				6	0.0	.4669	43.7
				7	0.0	.5678	35.4
4340 Steel	160.	0.4	-1,836	4	-.0002	.2567	162.4
				5	-.0007	.5248	126.9
				6	-.0005	.5557	113.5
				7	-.0005	.5557	108.5
Ti-6-4	158.	0.4	-1.836	4	-.0009	.2368	154.2
				5	-.0006	.4640	110.3
				6	-.0000	.4650	88.9
				7	.0001	.4752	84.2